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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of:		
	Robert Luffel, *et al.*	
Serial No.:	09/371,708	Examiner: David D. Davis
Filing Date:	August 9, 1999	Group Art Unit: 2652
Title:	LATERALLY EXPANDABLE MODULAR DATA STORAGE SYSTEM	Confirmation No. 9563
Attorney Dkt.:	HP 10980297-1	

CERTIFICATE OF EXPRESS MAILING

To: Assistant Commissioner for Patents
Box AF
Washington, D.C. 20231

I hereby certify that the foregoing **Transmittal of Appeal Brief (in duplicate); Appeal Brief including Appendix A and Appendix B (in triplicate); and post cards for return by the United States Patent and Trademark Office;** are all being deposited with the United States Postal Service addressed to the Assistant Commissioner for Patents, Box AF, Washington, D.C. 20231, via Express Mail No. EV 019514427 US, on this 2nd day of May, 2002.

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PATENT APPLICATION

ATTORNEY DOCKET NO. 10980297-1

IN THE
UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Robert W. Luffel, et al.

Confirmation No.: 9563

Application No.: 09/371,708

Examiner: D. Davis

Filing Date: 08-09-1999

Group Art Unit: 2652

Title: LATERALLY EXPANDABLE MODULAR DATA STORAGE SYSTEM

COMMISSIONER FOR PATENTS
Washington, D.C. 20231

TRANSMITTAL OF APPEAL BRIEF

Sir:

Transmitted herewith in **triplicate** is the Appeal Brief in this application with respect to the Notice of Appeal filed on **March 5, 2002**.

The fee for filing this Appeal Brief is (37 CFR 1.17(c)) $320.00.

(complete (a) or (b) as applicable)

The proceedings herein are for a patent application and the provisions of 37 CFR 1.136(a) apply.

( ) (a) Applicant petitions for an extension of time under 37 CFR 1.136 (fees: 37 CFR 1.17(a)-(d) for the total number of months checked below:

( )	one month	$110.00
( )	two months	$400.00
( )	three months	$920.00
( )	four months	$1440.00

( ) The extension fee has already been filled in this application.

(X) (b) Applicant believes that no extension of term is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition and fee for extension of time.

Please charge to Deposit Account **08-2025** the sum of $320.00. At any time during the pendency of this application, please charge any fees required or credit any over payment to Deposit Account 08-2025 pursuant to 37 CFR 1.25. Additionally please charge any fees to Deposit Account 08-2025 under 37 CFR 1.16 through 1.21 inclusive, and any other sections in Title 37 of the Code of Federal Regulations that may regulate fees. A duplicate copy of this sheet is enclosed.

Respectfully submitted,

Robert W. Luffel, et al.

By _____

Bruce E. Dahl

Attorney/Agent for Applicant(s)
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Date: **May 2, 2002**

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I hereby certify that this correspondence is being deposited with the United States Postal Service as Express mail in an envelope addressed to: Commissioner for Patents, Washington, D.C. 20231. Label No. EV019514427US

Date of Deposit: **May 2, 2002**

Typed Name: **Bruce E. Dahl**

Signature: _____

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In Re Application of:	)	
	)	
LUFFEL, Robert, W., *et al.*	)	
	)	Examiner: Davis, D.
Serial No. 09/337,802	)	
	)	Group Art Unit: 2652
Filing Date: June 22, 1999	)	
	)	Conf. No.: 9485
For: APPARATUS FOR TRANSLATING A CARTRIDGE ACCESS DEVICE	)	

APPEAL BRIEF

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Express Mail Label No. EV 019514413 US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In Re Application of:	)	
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LUFFEL, Robert, W., *et al.*	)	
	)	Examiner: Davis, D.
Serial No. 09/337,802	)	
	)	Group Art Unit: 2652
Filing Date: June 22, 1999	)	
	)	Conf. No.: 9485
For: APPARATUS FOR TRANSLATING A CARTRIDGE ACCESS DEVICE	)	

APPEAL BRIEF

To: The Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

This Appeal Brief is submitted in response to the final rejections of the claims dated October 22, 2001. A Notice of Appeal was filed on March 5, 2002.

REAL PARTY IN INTEREST

The assignee of the entire right, title, and interest in the patent application is Hewlett-Packard Company.

RELATED APPEALS AND INTERFERENCES

There is a related appeal of another United States patent application, serial no. 09/371,708, filed August 9, 1999, that may directly affect, or be directly affected by, or have a bearing on, the Board's decision. Application serial no. 09/371,708 is a continuation-in-part application of the application that is the subject of this appeal. There are currently no related interferences known to Appellant, Appellant's

legal representative, or the assignee which will directly affect, or be directly affected by, or have a bearing on, the Board's decision.

STATUS OF THE CLAIMS

Claims 1 and 3-24 are pending in the application. Claims 1 and 3-24 are rejected. The rejections of claims 1 and 3-24 are appealed. Specifically, claims 1 and 3-24 stand provisionally rejected under the judicially created doctrine of double patenting. Claims 1, 3-7, 12-19, and 24 stand rejected under Section 102 as being anticipated by Tadokoro. Claims 8-11 and 20-23 are not specifically rejected over Tadokoro, thus are allowable over Tadokoro.

STATUS OF AMENDMENTS

An amendment, dated December 14, 2001, was filed in response to the final office action, dated October 22, 2001. In an advisory action, paper no. 9, dated February 13, 2002, the examiner confirmed that claims 1 and 3-24 continue to stand rejected. It is not known whether the amendment was entered upon filing of the Notice of Appeal. That is, in paragraph 7 of the advisory action, the examiner failed to check either box (a) (that the amendment will not be entered) or box (b) (that the amendment will be entered). However, Appellants assume for the purposes of this appeal brief that the amendment was not entered, since it is the examiner's position that the proposed amendment raises new issues.

SUMMARY OF INVENTION

The present invention is directed to translation apparatus 10 for moving a cartridge access device 12 along a displacement path 14. In one embodiment, the translation apparatus 10 may comprise a first elongate gear rack 20 aligned along the displacement path 14 and a second elongate gear rack 22 positioned in spaced-apart relation to the first elongate gear rack 20, so that the second elongate gear rack 22 is aligned along the displacement path 14. A first elongate guide member 50 that is integral with the first elongate gear rack 20 also extends along the displacement path 14. A first bearing member 54

mounted to the cartridge access device engages the first elongate guide member 50. A first drive pinion 24 mounted to the cartridge access device 12 engages the first elongate gear rack 20. A second drive pinion 28 mounted to the cartridge access device 12 engages the second elongate gear rack 22. A pinion drive apparatus 32 operatively associated with the first and second drive pinions 24 and 28 rotates the first and second drive pinions 24 and 28 to move the cartridge access device 12 along the first and second elongate gear racks 20 and 22.

A significant advantage of the translation apparatus 10 of the present invention is that it provides a simple and convenient way to move the cartridge access device 12 in a lateral direction (i.e., along the displacement path 14). Moreover, the integral arrangement of the guide member 50 and gear rack 20 provides for greatly improved performance and ease of manufacture. The integral arrangement of the guide member 50 and the gear rack 20 also eliminates the need to align the guide member with the gear rack. Yet another advantage of the translation apparatus 10 is that it is readily expandable in the direction of the displacement path 14. For example, the displacement path 14 may be extended in length by simply positioning additional elongate gear racks adjacent the ends of the elongate gear racks 20, 22, 36, and 38, in the manner best seen in Figure 4. Such an arrangement allows for the convenient expansion of a data storage system that embodies the translation apparatus 10 according to the present invention.

The invention as claimed is summarized below with reference numerals and reference to the specification and drawings.

(Claim 1) Translation apparatus (10, Figures 1 - 3; p. 4, l. 27 - p. 18, l. 5) for moving a cartridge access device (12, Figures 1 - 3; p. 4, l. 27 - p. 7, l. 14; p. 9, l. 1 - p. 10, l. 5) along a displacement path (14, Figures 1 and 2, p. 4, l. 27 - p. 5, l. 14; p. 5, l. 25 - 32; p.6, l. 18 - 24; p. 9, l. 1 - 15; p. 10, l. 6 - 13), comprising:

a first elongate gear rack (20, Figures 1 - 3, p. 4, l. 32 - p. 7, l.14; p. 10, l. 6 - 36; p. 11, l. 25 - 35) aligned along the displacement path (14), said first elongate gear rack (20) having a

first end and a second end;

a first elongate guide member (50, Figures 1 - 3; p. 5, l. 32 - p. 6, l. 10; p. 7, l. 1 - 9; p. 10, l. 16 - 23; p. 11, l. 25 - 35) integral with said first elongate gear rack (20) and extending along the displacement path (14) substantially between the first and second ends of said first elongate gear rack (20);

a first bearing (54, Figure 3, p. 5, l. 32 - p. 6, l. 10; p. 16, l. 2 - p. 17, l. 6; p. 17, l. 21 - p. 18, l. 2) mounted to the cartridge access device (12), said first bearing (54) engaging said first elongate guide member (50);

a second elongate gear rack (22, Figures 1 - 3; p. 4, l. 35 - p. 7, l. 14; p. 11, l. 1 - 35) aligned along the displacement path (14) and positioned in spaced-apart relation to said first elongate gear rack (20), said second elongate gear rack (22) having a first end and a second end;

a first drive pinion (24, Figures 2 and 3, p. 5, l. 3 - 14; p. 6, l. 18 - p. 7, l. 14; p. 13, l. 32 - p. 14, l. 14) mounted to the cartridge access device (12), said first drive pinion (24) engaging said first elongate gear rack (20);

a second drive pinion (28, Figures 1- 3; p. 5, l. 3 - 14; p. 6, l. 18 - p. 7, l. 14; p. 13, l. 32 - p. 14, l. 14) mounted to the cartridge access device (12), said second drive pinion (28) engaging said second elongate gear rack (22); and

pinion drive apparatus (32, Figures 1- 3; p. 5, l. 10 - 14; p. 6, l. 18 - p. 7, l. 14; p. 14, l. 32 - p. 16, l. 1) operatively associated with said first and second drive pinions (24, 28), said pinion drive apparatus (32) rotating said first and second drive pinions (24, 28) to move the cartridge access device (12) between the first and second ends of said first and second elongate gear racks (20, 22).

(Claim 2) Claim 2 is canceled without prejudice to the subject matter contained therein.

(Claim 3) The translation apparatus (10) of claim 1, wherein said first elongate guide member

(50) comprises first and second opposed bearing surfaces (78 and 80, respectively, Figure 2, p. 10, l. 20 - 23; p. 16, l. 2 - p. 17, l.6) and wherein said first bearing (54) mounted to the cartridge access device (12) slidably engages the first and second opposed bearing surfaces (78 and 80) of said first elongate guide member (20).

(Claim 4) The translation apparatus (10) of claim 3, wherein said second elongate gear rack (22) includes a second elongate guide member (52, Figures 1 and 3; p. 5, l. 32 - p. 6, l. 10; p. 7, l. 1 - 9; p. 11, l. 1 - 35) that extends along the displacement path (14) substantially between the first and second ends of said second elongate gear rack (22) and wherein said translation apparatus (10) further comprises a second bearing (56, Figure 3; p. 5, l. 32 - p. 6, l. 10; p. 16, l. 9 - p. 17, l. 6; p. 17, l. 21 - p. 18, l. 2) mounted to the cartridge access device (12), said second bearing (56) engaging said second elongate guide member (52).

(Claim 5) The translation apparatus (10) of claim 4, wherein said second elongate guide member (52) comprises first and second opposed bearing surfaces (86 and 88, respectively, Figure 3, p. 11, l. 7 - 13; p. 16, l. 9 - p. 17, l.6) and wherein said second bearing (56) mounted to the cartridge access device (12) slidably engages the first and second opposed bearing surfaces (86 and 88) of said second elongate guide member (52).

(Claim 6) The translation apparatus (10) of claim 5, further comprising a third bearing (60, Figure 3, p. 6, l. 11 - 17; p. 7, l. 7 - 9; p. 17, l. 7 - p. 18, l. 2) mounted to the cartridge access device (12), said third bearing (60) contacting said first elongate gear rack (20) and allowing the cartridge access device (12) to move along the displacement path (14).

(Claim 7) The translation apparatus (10) of claim 6, wherein said third bearing (60) comprises a wheel.

(Claim 8) Translation apparatus (10, Figures 1 - 3; p. 4, l. 27 - p. 18, l. 5) for moving a cartridge access device (12, Figures 1 - 3; p. 4, l. 27 - p. 7, l. 14; p. 9, l. 1 - p. 10, l. 5) along a displacement path (14, Figures 1 and 2, p. 4, l. 27 - p. 5, l. 14; p. 5, l. 25 - 32; p.6, l. 18 - 24; p. 9, l. 1 - 15; p. 10, l. 6 - 13), comprising:

a first elongate gear rack (20, Figures 1 - 3, p. 4, l. 32 - p. 7, l.14; p. 10, l. 6 - 36; p. 11, l. 25 - 35) aligned along the displacement path (14), said first elongate gear rack (20) having a first end and a second end;

a second elongate gear rack (22, Figures 1 - 3; p. 4, l. 35 - p. 7, l. 14; p. 11, l. 1 - 35) aligned along the displacement path (14) and positioned in spaced-apart relation to said first elongate gear rack (20), said second elongate gear rack (22) having a first end and a second end;

a third elongate gear rack (36, Figures 1-3, p. 5, l. 15 - 24; p. 7, l. 19 - p. 8, l.4; p. 11, l. 36 - p. 12, l.34; p. 13, l. 26 - 31) positioned in generally parallel, spaced-apart relation to said first elongate gear rack (20);

a fourth elongate gear rack (38, Figures 1-3, p. 5, l. 15 - 24, p. 7, l. 19 - p. 8, l. 4; p.11, l. 36 - p. 12, l. 7; p. 12, l. 35 - p. 13, l. 31) positioned in generally parallel, spaced-apart relation to said second elongate gear rack (22) so that said first, second, third, and fourth elongate gear racks (20, 22, 36, and 38) define a generally rectangular, parallelopiped configuration with said first and third elongate gear racks (20 and 36) defining a bottom side of the generally rectangular, parallelopiped configuration and said second and fourth elongate gear racks (22 and 38) defining a top side of the generally rectangular, parallelopiped configuration;

a first drive pinion (24, Figures 2 and 3, p. 5, l. 3 - 14; p. 6, l. 18 - p. 7, l. 14; p. 13, l. 32 - p. 14, l. 14) mounted to the cartridge access device (12), said first drive pinion (24) engaging said first elongate gear rack (20);

a second drive pinion (28, Figures 1 - 3; p. 5, l. 3 - 14; p. 6, l. 18 - p. 7, l. 14; p. 13, l. 32 - p. 14, l. 14) mounted to the cartridge access device (12), said second drive pinion (28) engaging said second elongate gear rack (22); and

pinion drive apparatus (32, Figures 1- 3; p. 5, l. 10 - 14; p. 6, l. 18 - p. 7, l. 14; p. 14, l. 32 - p. 16, l. 1) operatively associated with said first and second drive pinions (24 and 28), said pinion drive apparatus (32) rotating said first and second drive pinions (24 and 28) to move the cartridge access device (12) between the first and second ends of said first and second elongate gear racks (20 and 22).

(Claim 9) The translation apparatus (10) of claim 8, further comprising:

a third drive pinion (40, Figures 2 and 3; p. 5, l. 20 - 24; p. 6, l. 30 - p. 7, l. 14; p. 14, l. 15 - 31) mounted to the cartridge access device (12) and operatively associated with said pinion drive apparatus (32), said third drive pinion (40) engaging said third elongate gear rack (36); and

a fourth drive pinion (42, Figures 1-3; p. 5, l. 20 - 24; p. 6, l. 30 - p. 7, l. 14; p. 14, l. 15 - 31) mounted to the cartridge access device (12) and operatively associated with said pinion drive apparatus (32), said fourth drive pinion (42) engaging said fourth elongate gear rack (38).

(Claim 10) The translation apparatus (10, 110, Figure 4)) of claim 9, further comprising:

a fifth elongate gear rack (not shown specifically, but see the arrangement illustrated in Figure 4 and described at p. 18, l. 26 - 29) having a first end and a second end, the first end of said fifth elongate gear rack being mounted adjacent the second end of said first elongate gear rack (e.g., 20, 120, Figure 4) so that said fifth elongate gear rack is aligned along the displacement path (e.g., 14, 114, Figure 4); and

a sixth elongate gear rack (e.g., 122', Figure 4, p. 18, l. 22 - 32) having a first end and a second end, the first end of said sixth elongate gear rack (122') being mounted adjacent the second end of said second elongate gear rack (e.g., 22, 122, Figure 4) so that said sixth elongate gear rack (122') is aligned along the displacement path (e.g., 14, 114, Figure 4).

(Claim 11) The translation apparatus (10, 110, Figure 4) of claim 10, further comprising:

a seventh elongate gear rack (136', Figure 4, p. 18, l. 22 - 32) having a first end and a second end, the first end of said seventh elongate gear rack (136') being mounted adjacent the second end of said third elongate gear rack (e.g., 36, 136, Figure 4) so that said seventh elongate gear rack (136') is aligned along the displacement path (e.g., 14, 114, Figure 4); and

an eighth elongate gear rack (138', Figure 4, p. 18, l. 22 - 32) having a first end and a second end, the first end of said eighth elongate gear rack (138') being mounted adjacent the second end of said fourth elongate gear rack (e.g., 38, 138, Figure 4) so that said eighth elongate gear rack (138') is aligned along the displacement path (14, 114, Figure 4).

(Claim 12) The translation apparatus (10) of claim 1, wherein said pinion drive apparatus (32) comprises:

a motor (19, Figures 2 and 3, p. 14, l. 32 - p. 15, l. 12) having a shaft;

a worm (21, Figures 2 and 3, p. 15, l. 4 - 12) attached to the shaft of said motor (19); and

a worm gear (23, Figures 2 and 3, p. 15, l. 4 - 12) operatively connected to said first and second drive pinions (24 and 28), said worm gear (23) mounted to engage said worm (21) mounted to the shaft of said motor (19).

(Claim 13) Translation apparatus (10, Figures 1 - 3; p. 4, l. 27 - p. 18, l. 5) for moving a cartridge access device (12, Figures 1 - 3; p. 4, l. 27 - p. 7, l. 14; p. 9, l. 1 - p. 10, l. 5) along a displacement path (14, Figures 1 and 2, p. 4, l. 27 - p. 5, l. 14; p. 5, l. 25 - 32; p.6, l. 18 - 24; p. 9, l. 1 - 15; p. 10, l. 6 - 13), comprising:

a first elongate gear rack (20, Figures 1 - 3, p. 4, l. 32 - p. 7, l.14; p. 10, l. 6 - 36; p. 11, l. 25 - 35) aligned along said displacement path (14), said first elongate gear rack (20) having a first end and a second end;

a first elongate guide member (50, Figures 1 - 3; p. 5, l. 32 - p. 6, l. 10; p. 7, l. 1 - 9; p. 10, l. 16 - 23; p. 11, l. 25 - 35) integral with said first elongate gear rack (20) so that said first

elongate guide member (50) extends along the displacement path (14);

a second elongate guide member (52, Figures 1 and 3; p. 5, l. 32 - p. 6, l. 10; p. 7, l. 1 - 9; p. 11, l. 1 - 35) extending along the displacement path (14) and positioned in spaced-apart relation to said first elongate guide member (50);

a first drive pinion (24, Figures 2 and 3, p. 5, l. 3 - 14; p. 6, l. 18 - p. 7, l. 14; p. 13, l. 32 - p. 14, l. 14) mounted to the cartridge access device (12), said first drive pinion (24) engaging said first elongate gear rack (20);

a first bearing (54, Figure 3, p. 5, l. 32 - p. 6, l. 10; p. 16, l. 2 - p. 17, l. 6; p. 17, l. 21 - p. 18, l. 2) mounted to the cartridge access device (12), said first bearing (54) engaging said first elongate guide member (50);

a second bearing (56, Figure 3; p. 5, l. 32 - p. 6, l. 10; p. 16, l. 9 - p. 17, l. 6; p. 17, l. 21 - p. 18, l. 2) mounted to the cartridge access device (12), said second bearing (56) engaging said second elongate guide member (52); and

pinion drive apparatus (32, Figures 1- 3; p. 5, l. 10 - 14; p. 6, l. 18 - p. 7, l. 14; p. 14, l. 32 - p. 16, l. 1) operatively associated with said first drive pinion (24), said pinion drive apparatus (32) rotating said first drive pinion (24) to move the cartridge access device (12) along the displacement path (14).

(Claim 14) The translation apparatus (10) of claim 13, further comprising:

a second elongate gear rack (22, Figures 1 - 3; p. 4, l. 35 - p. 7, l. 14; p. 11, l. 1 - 35) aligned along said displacement path (14) and positioned in spaced-apart relation to said first elongate gear rack (20); and

a second drive pinion (28, Figures 1- 3; p. 5, l. 3 - 14; p. 6, l. 18 - p. 7, l. 14; p. 13, l. 32 - p. 14, l. 14) mounted to the cartridge access device (12), said second drive pinion (28) engaging said second elongate gear rack (22).

(Claim 15) The translation apparatus (10) of claim 14, wherein said second elongate guide member (52) comprises an integral portion of said second elongate gear rack (22).

(Claim 16) The translation apparatus (10) of claim 14, wherein said first elongate guide member (50) comprises first and second opposed bearing surfaces (78 and 80, respectively, Figure 2, p. 10, l. 20 - 23; p. 16, l. 2 - p. 17, l.6) and wherein said first bearing (54) mounted to the cartridge access device (12) slidably engages the first and second opposed bearing surfaces (78 and 80) of said first elongate guide member (50).

(Claim 17) The translation apparatus (10) of claim 16, wherein said second elongate guide member (52) comprises first and second opposed bearing surfaces (86 and 88, respectively, Figure 3, p. 11, l. 7 - 13; p. 16, l. 9 - p. 17, l.6) and wherein said second bearing (56) mounted to the cartridge access device (12) slidably engages the first and second opposed bearing surfaces (86 and 88) of said second elongate guide member (52).

(Claim 18) The translation apparatus (10) of claim 17, further comprising a third bearing (60, Figure 3, p. 6, l. 11 - 17; p. 7, l. 7 - 9; p. 17, l. 7 - p. 18, l. 2) mounted to the cartridge access device (12), said third bearing (60) contacting said first elongate gear rack (20) and allowing the cartridge access device (12) to move along the displacement path (14).

(Claim 19) The translation apparatus (10) of claim 18, wherein said third bearing (60) comprises a wheel.

(Claim 20) The translation apparatus (10) of claim 18, further comprising:

a third elongate gear rack (36, Figures 1-3, p. 5, l. 15 - 24; p. 7, l. 19 - p. 8, l.4; p. 11, l. 36 - p. 12, l.34; p. 13, l. 26 - 31) positioned in generally parallel, spaced-apart relation to said

first elongate gear rack (20); and

a fourth elongate gear rack (38, Figures 1-3, p. 5, l. 15 - 24, p. 7, l. 19 - p. 8, l. 4; p.11, l. 36 - p. 12, l. 7; p. 12, l. 35 - p. 13, l. 31) positioned in generally parallel, spaced-apart relation to said second elongate gear rack (22) so that said first, second, third, and fourth elongate gear racks (20, 22, 36, and 38) define a generally rectangular, parallelopiped configuration with said first and third elongate gear racks (20 and 36) defining a bottom side of the generally rectangular, parallelopiped configuration and said second and fourth elongate gear racks (22 and 38) defining a top side of the generally rectangular, parallelopiped configuration.

(Claim 21) The translation apparatus (10) of claim 20, further comprising:

a third drive pinion (40, Figures 2 and 3; p. 5, l. 20 - 24; p. 6, l. 30 - p. 7, l. 14; p. 14, l. 15 - 31) mounted to the cartridge access device (12) and operatively associated with said pinion drive apparatus (32), said third drive pinion (40) engaging said third elongate gear rack (36); and

a fourth drive pinion (42, Figures 1-3; p. 5, l. 20 - 24; p. 6, l. 30 - p. 7, l. 14; p. 14, l. 15 - 31) mounted to the cartridge access device (12) and operatively associated with said pinion drive apparatus (32), said fourth drive pinion (42) engaging said fourth elongate gear rack (38).

(Claim 22) The translation apparatus (10, 110, Figure 4) of claim 21, further comprising:

a fifth elongate gear rack (not shown specifically, but see the arrangement illustrated in Figure 4 and described at p. 18, l. 26 - 29) having a first end and a second end, the first end of said fifth elongate gear rack being mounted adjacent the second end of said first elongate gear rack (e.g., 20, 120, Figure 4) so that said fifth elongate gear rack is aligned along the displacement path (e.g., 14, 114, Figure 4); and

a sixth elongate gear rack (122', Figure 4, p. 18, l. 22 - 32) having a first end and a second end, the first end of said sixth elongate gear rack being mounted adjacent the second end of said second elongate gear rack (e.g., 22, 122, Figure 4) so that said sixth elongate gear rack

(122') is aligned along the displacement path (e.g., 14, 114, Figure 4).

(Claim 23) The translation apparatus (10, 110, Figure 4) of claim 22, further comprising:

a seventh elongate gear rack (136', Figure 4, p. 18, l. 22 - 32) having a first end and a second end, the first end of said seventh elongate gear rack (136') being mounted adjacent the second end of said third elongate gear rack (e.g., 36, 136, Figure 4) so that said seventh elongate gear rack (136') is aligned along the displacement path (e.g., 14, 114, Figure 4); and

an eighth elongate gear rack (138', Figure 4, p. 18, l. 22 - 32) having a first end and a second end, the first end of said eighth elongate gear rack (138') being mounted adjacent the second end of said fourth elongate gear rack (e.g., 38, 138, Figure 4) so that said eighth elongate gear rack (138') is aligned along the displacement path (e.g., 14, 114, Figure 4).

(Claim 24) Translation apparatus (10, Figures 1 - 3; p. 4, l. 27 - p. 18, l. 5) for moving a cartridge access device (12, Figures 1 - 3; p. 4, l. 27 - p. 7, l. 14; p. 9, l. 1 - p. 10, l. 5) along a displacement path (14, Figures 1 and 2, p. 4, l. 27 - p. 5, l. 14; p. 5, l. 25 - 32; p.6, l. 18 - 24; p. 9, l. 1 - 15; p. 10, l. 6 - 13), comprising:

an elongate gear rack (e.g., 20, Figures 1 - 3, p. 4, l. 32 - p. 7, l.14; p. 10, l. 6 - 36; p. 11, l. 25 - 35) aligned along the displacement path (14);

guide means (e.g., 50, Figures 1 - 3; p. 5, l. 32 - p. 6, l. 10; p. 7, l. 1 - 9; p. 10, l. 16 - 23; p. 11, l. 25 - 35) integral with said elongate gear rack (20) for guiding the cartridge access device (12) along the displacement path (14);

a drive pinion (e.g., 24, Figures 2 and 3, p. 5, l. 3 - 14; p. 6, l. 18 - p. 7, l. 14; p. 13, l. 32 - p. 14, l. 14) mounted to the cartridge access device (12), said drive pinion (24) engaging said elongate gear rack (20); and

pinion drive means (32, Figures 1- 3; p. 5, l. 10 - 14; p. 6, l. 18 - p. 7, l. 14; p. 14, l. 32 - p. 16, l. 1) operatively associated with said drive pinion (24) for rotating said first drive pinion

(24) to move the cartridge access device (12) along the displacement path (14).

ISSUES

1. Whether claims 1 and 3-24 are unpatentable under the judicially-created doctrine of double patenting over claims 1-24 of Application Serial No. 09/371,708.

2. Whether claims 1, 3-7, 12-19, and 24 are unpatentable under 35 U.S.C. §102(e) as being unpatentable over Tadokoro.

GROUPING OF THE CLAIMS

None of the claims stand or fall together. Each claim is patentable on independent grounds as set forth in the ARGUMENT.

ARGUMENT

Opening Statement

The Tadokoro reference does not disclose at least a guide member that is *integral* with a gear rack. To the contrary, Tadokoro utilizes *separate* guide members and gear racks. Accordingly, Tadokoro cannot support the examiner's anticipation rejections under Section 102.

Appellant's Invention

Appellants' invention is directed to translation apparatus for moving cartridge access devices along arrays of data cartridges stored in data storage systems. In one embodiment, the translation apparatus involves first and second elongate gear racks that are positioned in spaced-apart relation and aligned along a displacement path. The first elongate gear rack includes an integral elongate guide member that also extends along the displacement path. A first bearing member mounted to the cartridge access device engages the first elongate guide member. A first drive pinion mounted to the cartridge access device engages the first elongate gear rack. A second drive pinion mounted to the cartridge access

device engages the second elongate gear rack. A pinion drive apparatus operatively associated with the first and second drive pinions and rotates the first and second drive pinions to move the cartridge access device along the first and second elongate gear racks.

The integral gear rack and guide member arrangement of the present invention provides for improved positioning accuracy of the cartridge access device, eliminates the need for separate guide members and gear racks, and eliminates the need for such separate guide members and gear racks to be aligned with respect to one another.

Background

Many different types of data storage and handling systems exist and are being used to store data cartridges at known locations and to retrieve a desired cartridge so that data may be written to or read from the data cartridge. Such data storage and handling systems are often referred to as "juke box" data storage systems, particularly if they can accommodate a large number of individual data cartridges.

While the data cartridges may be arranged within the data storage system in any of a wide variety of configurations, many juke box data storage systems are designed so that the data cartridges are stored in one or more horizontal rows or arrays. If so, the data storage system is usually provided with a positioning apparatus for moving a cartridge access device along the array of cartridges so that the cartridge access device can access selected data cartridges stored in the array. Depending on the particular system, the cartridge access device may comprise a cartridge engaging assembly or "picker" which may be adapted to engage the selected data cartridge, withdraw it from its storage location, and carry it to a cartridge read/write device located elsewhere within the data storage system. The read/write device may then be used to read data from or write data two the cartridge. Once the read/write operation is complete, the cartridge engaging assembly or picker may withdraw the data cartridge from the read/write device and return it to the appropriate location within the cartridge storage array. In another type of system, the cartridge access device may comprise the read/write device itself, in which case the data cartridge may be read from or written to without the need to carry the data cartridge to a separate

read/write device.

Regardless of the particular type of cartridge access device that is utilized by the data storage system, the positioning system used to move the cartridge access device along the cartridge storage array must be capable of moving the cartridge access device along the cartridges stored in the array so that the desired data cartridge may be accessed. One type of positioning system, often referred to as a "lead-screw" system, mounts the cartridge access device on a lead-screw which, when turned, moves the cartridge access device back and forth along the array of cartridges. While such lead-screw positioning systems are being used, they are not without their problems. For example, in such a system the cartridge access device may be cantilevered on the lead-screw which may result in excessive transverse or rotational movement of the cartridge access device. Such excessive movement reduces positional accuracy and may make it difficult for the cartridge access device to reliably engage the desired data cartridge on a repeated basis.

Partly in an effort to solve the foregoing problems, positioning systems have been developed which utilize separate guide rails or tracks to guide the cartridge access device along the array of cartridges. The cartridge access device is mounted to the separate guide rails or tracks and the lead-screw is then used only to move the cartridge access device to the desired location. Alternatively, a wire-rope (i.e., cable) drive system may be used to move the cartridge access device. While such systems generally provide for increased positional accuracy of a simple cantilevered type of lead-screw arrangement, they are still not without their disadvantages. For example, the guide rail or track assemblies usually comprise machined components finished to a high degree of precision, which adds to the overall cost of the data storage system. Moreover, the guide rail or track assemblies are often difficult to align and may become mis-aligned during subsequent shipping or movement of the data storage system. If the mis-alignment is substantial, it may be necessary to re-align and re-calibrate the positioning system before the data storage system can be placed in operation.

Consequently, a need remains for a positioning system for moving a cartridge access device along an array of cartridges that provide increased positional accuracy to reduce errors due to mis-

alignment of the cartridge access device. Such increased positional accuracy should be achieved with a minimum number of components to maximize reliability and reduce cost, yet not require the use of expensive, precision-machined components and guide rails. Additional advantages could be realized by reducing the amount of time required to align and calibrate the assembly during production and by reducing the likelihood of subsequent mis-alignment due to shipping or rough handling. Ideally, the positioning system should require little space, thereby allowing for a reduction in the overall size of the data storage system or allowing for an increased number of data cartridges to be stored within the system.

Discussion of the Reference

Tadokoro, *et al.*, U.S. Patent No. 6,166,877 (Tadokoro). The Tadokoro reference discloses a cassette auto changer system that includes, among other things, a selection member for selecting between a plurality of cassettes. More specifically, with respect to the embodiment illustrated in Figures 19-21, Tadokoro discloses a cassette transfer mechanism 2 with upper and lower horizontally arranged gear rack members 32 disposed so as to engage upper and lower guide rails 8 positioned on each of the consoles A-D. A vertical pillar 30 is supported between the upper and lower guide rails 8 so as to be moveable in the horizontal plane. Upper and lower end portions 30a and 30b attached to each end of the pillar 30 include a plurality of guide rollers 33 for pressingly engaging the guide rails 8 at three sides thereof to provide stable support and rolling movement for the cassette transport mechanism 2. A pulley 35 mounted on the drive shaft of motor 34 engages a timing belt 36 which also engages a drive pulley 37 on rotatable shaft 38. Drive gears 39 are engaged with adjacent reduction gears 40 at each side thereof. Smaller pinion gears 41 are coaxially disposed at upper sides of the upper reduction gears 40 and lower sides of the lower reduction gears 40 to engage gear teeth formed on the upper and lower rack members 32.

ISSUE 1: WHETHER CLAIMS 1 AND 3-24 ARE UNPATENTABLE UNDER THE JUDICIALLY-CREATED DOCTRINE OF DOUBLE PATENTING.

In the first office action, paper no. 4, dated May 8, 2001, the examiner *provisionally* rejected claims 1-24 under the judicially-created doctrine of double patenting over claims 1-24 of co-pending patent application serial no. 09/371,708. In responding to that office action, Appellants acknowledged the examiner's *provisional* double patenting rejection, and indicated that they would respond to the rejection by filing a terminal disclaimer upon the indication that the claims are otherwise allowable.

In the final office action, paper no. 7, dated October 22, 2002, the examiner repeated the identical provisional double patenting rejection. The examiner's provisional double patenting rejection is not ripe for consideration on appeal since it is provisional in nature. That is, since no claims have yet issued, it is not possible to make a meaningful determination as to whether a double patenting rejection would be warranted. Consequently, Appellants' request that the double patenting rejection be held in abeyance until claims of the '708 application are allowed.

ISSUE 2: WHETHER CLAIMS 1, 3-7, 12-19, AND 24 ARE UNPATENTABLE UNDER 35 U.S.C. §102(e) AS BEING ANTICIPATED BY TADOKORO.

Claims 1, 3-7, 12-19, and 24 currently stand rejected under Section 102(e) as being anticipated by Tadokoro. Appellants note that the examiner did not reject claims 8-11 and 20-23 over Tadokoro. Consequently, Appellants regard claims 8-11 and 20-23 as being allowable over Tadokoro. Stated another way, by failing to specifically reject claims 8-11 and 20-23 over any prior art reference, the examiner has failed to establish the required *prima-facie* case of unpatentability of claims 8-11 and 20-23.

Legal Standard For Rejecting Claims
Under 35 U.S.C. §102

The standard for lack of novelty, that is, for "anticipation," under 35 U.S.C. §102 is one of strict identity. To anticipate a claim for a patent, a single prior source must contain all its essential elements. *Hybritech, Inc. v. Monoclonal Antibodies, Inc.*, 231 USPQ 81, 90 (Fed. Cir. 1986). Invalidity for anticipation requires that all of the elements and limitations of the claims be found within a single prior

art reference. *Scripps Clinic & Research Foundation v. Genentech, Inc.*, 18 USPQ2d 1001 (Fed. Cir. 1991). Every element of the claimed invention must be literally present, arranged as in the claim. *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989) (finding that the jury had been erroneously instructed that anticipation may be shown by equivalents, a legal theory that is pertinent to obviousness under Section 103, not to anticipation under Section 102). "The identical invention must be shown in as complete detail as is contained in the patent claim." MPEP §2131 (7th Ed. 1998) (citing *Richardson, supra*). Furthermore, functional language, preambles, and language in "whereby," "thereby," and "adapted to" clauses cannot be disregarded. *Pac-Tec, Inc. v. Amerace Corp.*, 14 USPQ2d 1871 (Fed. Cir. 1990).

The burden of establishing a *prima-facie* case of anticipation resides with the U.S. Patent and Trademark Office. *Ex parte Skinner*, 2 USPQ2d 1788, 1788-1789 (Bd. Pat. Int. 1986) (holding that the examiner failed to establish *prima-facie* case of anticipation). The examiner has "the burden of proof . . . to produce the factual basis for its rejection of an application under Sections 102 or 103." *In re Piasecki*, 223 USPQ 785, 788 (Fed. Cir. 1984) (quoting *In re Warner*, 154 USPQ 173, 177 (CCPA 1967)). Only if that burden is met, does the burden of going forward shift to the applicant.

The Examiner's Rejections

The examiner rejected claims 1, 3-7, 12-19, and 24 under 35 U.S.C. §102(e) as being anticipated by Tadokoro. It is the position of the examiner that the Tadokoro reference discloses each and every element and meets each and every limitation set forth in claims 1, 3-7, 12-19, and 24. The examiner's rejections are improper in that Tadokoro fails to disclose elements and limitations that are specifically required by the rejected claims. Consequently, the examiner has failed to establish the required *prima-facie* case of anticipation.

Turning now to the present invention, each of claims 1 and 3-7 requires that the translation apparatus comprise a first elongate gear rack (e.g., 20) and a first elongate guide member (e.g., 50) that is **integral** with the first elongate gear rack. See also Figures 1-3 of the currently pending application.

The Tadokoro device does not meet this limitation. To the contrary, Tadokoro describes **separate** gear racks 32 and guide members 8, and they are shown as separate members in the drawings of the Tadokoro patent. See, for example, Figures 20 and 22 of Tadokoro. Moreover, in col. 14, lines 9-13, Tadokoro describes that the rack members 32 are "disposed so as to engage the upper and lower guide rails 8, 8." That Tadokoro describes the rack members 32 as being "disposed to engage" the upper and lower guide rails 8 means that they are separate, not integral, elements. Significantly, the examiner has never identified any language or drawing figure in Tadokoro that contradicts this fact. Stated another way, Tadokoro's two-piece guide member and gear rack arrangement teaches away from the one-piece, integral arrangement of the present invention.

The Appellants made the foregoing points in their response to the first office action, only to have them mis-understood by the examiner. That is, in the "Response to Arguments" section of the final office action, the examiner responded by erroneously asserting that Appellants must show, e.g., by comparative testing or results, "that the guide member and gear rack of Tadokoro would yield (*sic*, would not yield) similar results and advantages as those purported by Appellants on page 10." See, for example, page 3, section 4 of the examiner's final office action. The examiner's position is unsustainable in that it does not represent the test for anticipation. Anticipation requires an identity of elements and limitations. Tadokoro does not contain those elements and limitations. Therefore, Tadokoro cannot anticipate. That is, each of claims 1 and 3-7 requires a guide member 50 that is **integral** with the guide rail 20. Tadokoro's guide rails 8 are **separate** from his gear racks 32. Therefore, Tadokoro cannot anticipate any of claims 1 and 3-7 as a matter of law.

Perhaps recognizing that Tadokoro fails to disclose a guide member that is integral with a gear rack, the examiner, on page 4 of the final office action, asserts that the term "integral" does not necessarily mean one piece. Appellants disagree. The term integral, as used in the currently pending claims means just that, i.e., that the guide member is formed from the same member as the gear rack. This arrangement is disclosed in the specification and is responsible for a significant advantage of the invention, i.e., that there is no need to separately align the gear rack and guide member. While the

examiner asserts that the courts have defined integral to mean "rigidly secured, fastened or welded," the examiner provides no citation of any case to support his statement. Even if he did, such a citation would not be controlling in this case, as claim terms are to be construed in light of the teachings of the specification. See, for example, *CVI/Beta Ventures, Inc. v. Tura LP*, 42 USPQ2d 1577 (Fed. Cir. 1997). Reference to the currently pending specification makes clear that the guide member and gear racks are formed from the same member, thus giving meaning to the term "integral" as that term is used in the currently pending claims. See, for example, the description contained at page 7, lines 27-30:

> ". . .since the lateral positioning of the cartridge access device 12 is provided by the guide member portions 50 and 52 provided on the first and second elongate gear racks 20 and 22."

and on page 10, lines 16-20:

> "The first or lower elongate gear rack 20 also may be provided with an elongate guide member 50 which, in one preferred embodiment, may take the form of a turned-up edge of the elongate gear rack 20, as is also best seen in Figure 2."

and on page 11, lines 31-35 (when discussing an example embodiment):

> ". . .both the lower and upper gear racks 20 and 22 are fabricated from sheet metal with the respective guide member portions 50 and 52 thereof comprising up-turned and down-turned edge portions, respectively."

In summation, the Tadokoro reference fails to disclose each and every element set forth in claim 1. That is, Tadokoro does not disclose at least:

"Translation apparatus for moving a cartridge access device along a displacement path, comprising:

a first elongate gear rack aligned along the displacement path, said first elongate gear rack having a first end and a second end;

<u>a first elongate guide member integral with said first elongate gear rack and extending along the displacement path substantially between the first and second ends of said first elongate gear rack</u>;

a first bearing mounted to the cartridge access device, said first bearing engaging said first elongate guide member;

a second elongate gear rack aligned along the displacement path and positioned in spaced-apart relation to said first elongate gear rack, said second elongate gear rack having a first end and a second end;

a first drive pinion mounted to the cartridge access device, said first drive pinion engaging said first elongate gear rack;

a second drive pinion mounted to the cartridge access device, said second drive pinion engaging said second elongate gear rack; and

pinion drive apparatus operatively associated with said first and second drive pinions, said pinion drive apparatus rotating said first and second drive pinions to move the cartridge access device between the first and second ends of said first and second elongate gear racks."

Claim 3 is allowable on further independent grounds in that Tadokoro does not disclose the translation apparatus as defined by claim 1, wherein the first elongate guide member comprises "first and second opposed bearing surfaces and wherein said first bearing mounted to the cartridge access device slidably engages the first and second opposed bearing surfaces" of the first elongate guide member, as set forth in claim 3. Tadokoro's vertical guide member is guided along the guide member 8 by wheels 33, not by slidable engagement. See Figure 22 of Tadokoro. Because Tadokoro does not separately meet the limitations of claim 3, Tadokoro cannot anticipate claim 3.

Claim 4 is allowable on further independent grounds in that the Tadokoro reference does not disclose the translation apparatus as defined by claim 3, wherein the second elongate gear rack includes "a second elongate guide member that extends along the displacement path" and wherein the translation apparatus further comprises "a bearing mounted to the cartridge access device, the second bearing engaging said second elongate guide member," as set forth in claim 4. Here again, any comparison of claim 4 with Tadokoro is inapt since Tadokoro's gear rack 32 is not a guide member. That is, since Tadokoro gear rack is not a guide member, there is no starting point for determining whether Tadokoro's gear rack includes "a second elongate guide member" as that term is to be construed in the context of

claim 4. Tadokoro cannot anticipate claim 4, because Tadokoro fails to meet the additional structural limitations recited in claim 4.

Claim 5 is allowable on further independent grounds in that Tadokoro does not disclose the translation apparatus as defined by claim 4, wherein the second elongate guide member comprises "first and second opposed bearing surfaces and wherein said second bearing mounted to the cartridge access device slidably engages the first and second opposed bearing surfaces" of the second elongate guide member as set forth in claim 5. Tadokoro's vertical guide member is guided along the guide member 8 by wheels 33, not by slidable engagement. See Figure 22 of Tadokoro. Accordingly, Tadokoro cannot anticipate claim 6.

Claim 6 is allowable on further independent grounds in that the Tadokoro reference does not disclose the translation apparatus as defined by claim 5, further comprising a "third bearing mounted to the cartridge access device, said third bearing contacting said first elongate gear rack" as set forth in claim 6. Tadokoro's gear rack 32 does not provide a guidance function nor does Tadokoro disclose a bearing that contacts his gear rack. The failure of Tadokoro to disclose a bearing that contacts a gear rack means that Tadokoro cannot anticipate claim 6.

Claim 7 is allowable on further independent grounds in that Tadokoro does not disclose the translation apparatus of claim 6, wherein the third bearing comprises a wheel. Again, Tadokoro discloses no third bearing that contacts a gear rack, much less a wheel that contacts a gear rack. Instead, Tadokoro's wheel contacts his guide member 8, not his gear rack 32. Therefore, Tadokoro cannot anticipate claim 7.

Claim 12 is believed to be allowable on further independent grounds in that the Tadokoro reference does not disclose the translation apparatus of claim 1, wherein the pinion drive apparatus comprises "a motor. . . a worm attached to the shaft of the motor and a worm gear operatively connected to said first and second drive pinions. . ." the worm gear also engaging the worm as set forth in claim 12. Tadokoro discloses a motor 34 that drives the pinions 41 via a drive belt 36. See Figure 20 of Tadokoro. A drive belt 36 is not a worm and worm gear. Since these additional limitations of claim 12 are not met,

Tadokoro cannot anticipate claim 12.

Independent claim 13 contains similar limitations that are not met by the Tadokoro reference. Specifically, claim 13 requires a "first elongate gear rack" and a "first elongate guide member integral with said first elongate gear rack." Again, Tadokoro's guide members 8 are not integral with his gear racks 32. Indeed, Tadokoro specifically teaches away from such an arrangement by stating that the rack members 32 engage the rails 8. Clearly, Tadokoro's guide members cannot be said to be integral with the gear rack, as specifically required by claim 13. Again, because the Tadokoro reference does not disclose an "elongate guide member" that is "integral with" a gear rack, Tadokoro cannot anticipate claim 13. Consequently, claim 13 is also allowable under Section 102(e).

Stated another way, independent claim 13 is allowable over Tadokoro in that Tadokoro fails to disclose at least:

"Translation apparatus for moving a cartridge access device along a displacement path, comprising:

a first elongate gear rack aligned along said displacement path, said first elongate gear rack having a first end and a second end;

a first elongate guide member integral with said first elongate gear rack so that said first elongate guide member extends along the displacement path;

a second elongate guide member extending along the displacement path and positioned in spaced-apart relation to said first elongate guide member;

a first drive pinion mounted to the cartridge access device, said first drive pinion engaging said first elongate gear rack;

a first bearing mounted to the cartridge access device, said first bearing engaging said first elongate guide member;

a second bearing mounted to the cartridge access device, said second bearing engaging said second elongate guide member; and

pinion drive apparatus operatively associated with said first drive pinion, said pinion

drive apparatus rotating said first drive pinion to move the cartridge access device along the displacement path."

Claim 14 is allowable on further independent grounds in that claim 14 depends from claim 13, which is allowable.

Claim 15 is allowable on further independent grounds in that Tadokoro does not disclose the translation apparatus as defined by 14, wherein the second elongate guide member "comprises an integral portion of said second elongate gear rack" as set forth in claim 15. Tadokoro's guide members 8 are not integral with his gear racks 32. In fact, Tadokoro specifically teaches away from such an arrangement by stating that the rack members 32 **engage** the rails 8, clearly implying that the two comprise separate, not integral, components. Again, because the Tadokoro reference does not disclose a "second elongate guide member" that comprises an "integral portion of said second elongate gear rack," Tadokoro cannot anticipate claim 15.

Claim 16 is allowable on further independent grounds in that Tadokoro does not disclose the translation apparatus as defined by claim 14, wherein the first elongate guide member comprises "first and second opposed bearing surfaces and wherein said first bearing mounted to the cartridge access device slidably engages the first and second opposed bearing surfaces" of the first elongate guide member, as set forth in claim 16. Tadokoro's vertical guide member is guided along the guide member 8 by wheels 33, not by slidable engagement. See Figure 22 of Tadokoro. Because Tadokoro does not separately meet the limitations of claim 16, Tadokoro cannot anticipate claim 16.

Claim 17 is allowable on further independent grounds in that Tadokoro does not disclose the translation apparatus as defined by claim 16, wherein the second elongate guide member comprises "first and second opposed bearing surfaces and wherein said second bearing mounted to the cartridge access device slidably engages the first and second opposed bearing surfaces" of the second elongate guide member as set forth in claim 17. Tadokoro's vertical guide member is guided along the guide member 8 by wheels 33, not by slidable engagement. See Figure 22 of Tadokoro. Accordingly, Tadokoro cannot

anticipate claim 17.

Claim 18 is allowable on further independent grounds in that the Tadokoro reference does not disclose the translation apparatus as defined by claim 17, further comprising a "third bearing mounted to the cartridge access device, said third bearing contacting said first elongate gear rack" as set forth in claim 18. Tadokoro's gear rack 32 does not provide a guidance function nor does Tadokoro disclose a bearing that contacts his gear rack. The failure of Tadokoro to disclose a bearing that contacts a gear rack means that Tadokoro cannot anticipate claim 18.

Claim 19 is allowable on further independent grounds in that Tadokoro does not disclose the translation apparatus of claim 18, wherein the third bearing comprises a wheel. Again, Tadokoro discloses no third bearing that contacts a gear rack, much less a wheel that contacts a gear rack. Therefore, Tadokoro cannot anticipate claim 19.

Independent claim 24 contains similar limitations that are not met by the Tadokoro reference. Specifically, claim 24 requires "elongate gear rack means" and "guide means integral with said elongate gear rack." Again, Tadokoro's guide members 8 are not integral with his gear racks 32. In fact, Tadokoro specifically teaches away from such an arrangement by stating that the rack members 32 engage the rails 8, clearly implying that the two comprise separate components. Because the Tadokoro reference does not disclose "guide means" that is "integral with" an "elongate gear rack," Tadokoro cannot anticipate claim 24. Consequently, claim 24 is also allowable under Section 102(e).

Stated another way, independent claim 24 is allowable over Tadokoro in that Tadokoro fails to disclose at least:

> "Translation apparatus for moving a cartridge access device along a displacement path, comprising:
>
> an elongate gear rack aligned along the displacement path;
>
> guide means integral with said elongate gear rack for guiding the cartridge access device along the displacement path;
>
> a drive pinion mounted to the cartridge access device, said drive pinion engaging said

elongate gear rack; and

pinion drive means operatively associated with said drive pinion for rotating said first drive pinion to move the cartridge access device along the displacement path."

CONCLUSION

The Tadokoro reference does not disclose at least a guide member that is integral with a gear rack. Therefore, Tadokoro cannot be used to establish the required *prima-facie* case of anticipation under Section 102. Accordingly, Appellants urge the Board to reverse the examiner's rejections of claims 1, 3-7, 12-19, and 24.

Respectfully submitted,

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APPENDIX A

1. Translation apparatus for moving a cartridge access device along a displacement path, comprising:

a first elongate gear rack aligned along the displacement path, said first elongate gear rack having a first end and a second end;

a first elongate guide member integral with said first elongate gear rack and extending along the displacement path substantially between the first and second ends of said first elongate gear rack;

a first bearing mounted to the cartridge access device, said first bearing engaging said first elongate guide member;

a second elongate gear rack aligned along the displacement path and positioned in spaced-apart relation to said first elongate gear rack, said second elongate gear rack having a first end and a second end;

a first drive pinion mounted to the cartridge access device, said first drive pinion engaging said first elongate gear rack;

a second drive pinion mounted to the cartridge access device, said second drive pinion engaging said second elongate gear rack; and

pinion drive apparatus operatively associated with said first and second drive pinions, said pinion drive apparatus rotating said first and second drive pinions to move the cartridge access device between the first and second ends of said first and second elongate gear racks.

2. Claim 2 is canceled without prejudice to the subject matter contained therein.

3. The translation apparatus of claim 1, wherein said first elongate guide member comprises first and second opposed bearing surfaces and wherein said first bearing mounted to the cartridge access device slidably engages the first and second opposed bearing surfaces of said first elongate guide

member.

4. The translation apparatus of claim 3, wherein said second elongate gear rack includes a second elongate guide member that extends along the displacement path substantially between the first and second ends of said second elongate gear rack and wherein said translation apparatus further comprises a second bearing mounted to the cartridge access device, said second bearing engaging said second elongate guide member.

5. The translation apparatus of claim 4, wherein said second elongate guide member comprises first and second opposed bearing surfaces and wherein said second bearing mounted to the cartridge access device slidably engages the first and second opposed bearing surfaces of said second elongate guide member.

6. The translation apparatus of claim 5, further comprising a third bearing mounted to the cartridge access device, said third bearing contacting said first elongate gear rack and allowing the cartridge access device to move along the displacement path.

7. The translation apparatus of claim 6, wherein said third bearing comprises a wheel.

8. Translation apparatus for moving a cartridge access device along a displacement path, comprising:

a first elongate gear rack aligned along the displacement path, said first elongate gear rack having a first end and a second end;

a second elongate gear rack aligned along the displacement path and positioned in spaced-apart relation to said first elongate gear rack, said second elongate gear rack having a first end and a second end;

a third elongate gear rack positioned in generally parallel, spaced-apart relation to said first elongate gear rack;

a fourth elongate gear rack positioned in generally parallel, spaced-apart relation to said second elongate gear rack so that said first, second, third, and fourth elongate gear racks define a generally rectangular, parallelopiped configuration with said first and third elongate gear racks defining a bottom side of the generally rectangular, parallelopiped configuration and said second and fourth elongate gear racks defining a top side of the generally rectangular, parallelopiped configuration;

a first drive pinion mounted to the cartridge access device, said first drive pinion engaging said first elongate gear rack;

a second drive pinion mounted to the cartridge access device, said second drive pinion engaging said second elongate gear rack; and

pinion drive apparatus operatively associated with said first and second drive pinions, said pinion drive apparatus rotating said first and second drive pinions to move the cartridge access device between the first and second ends of said first and second elongate gear racks.

9. The translation apparatus of claim 8, further comprising:

a third drive pinion mounted to the cartridge access device and operatively associated with said pinion drive apparatus, said third drive pinion engaging said third elongate gear rack; and

a fourth drive pinion mounted to the cartridge access device and operatively associated with said pinion drive apparatus, said fourth drive pinion engaging said fourth elongate gear rack.

10. The translation apparatus of claim 9, further comprising:

a fifth elongate gear rack having a first end and a second end, the first end of said fifth

elongate gear rack being mounted adjacent the second end of said first elongate gear rack so that said fifth elongate gear rack is aligned along the displacement path; and

a sixth elongate gear rack having a first end and a second end, the first end of said sixth elongate gear rack being mounted adjacent the second end of said second elongate gear rack so that said sixth elongate gear rack is aligned along the displacement path.

11. The translation apparatus of claim 10, further comprising:

a seventh elongate gear rack having a first end and a second end, the first end of said seventh elongate gear rack being mounted adjacent the second end of said third elongate gear rack so that said seventh elongate gear rack is aligned along the displacement path; and

an eighth elongate gear rack having a first end and a second end, the first end of said eighth elongate gear rack being mounted adjacent the second end of said fourth elongate gear rack so that said eighth elongate gear rack is aligned along the displacement path.

12. The translation apparatus of claim 1, wherein said pinion drive apparatus comprises:

a motor having a shaft;

a worm attached to the shaft of said motor; and

a worm gear operatively connected to said first and second drive pinions, said worm gear mounted to engage said worm mounted to the shaft of said motor.

13. Translation apparatus for moving a cartridge access device along a displacement path, comprising:

a first elongate gear rack aligned along said displacement path, said first elongate gear rack having a first end and a second end;

a first elongate guide member integral with said first elongate gear rack so that said first elongate guide member extends along the displacement path;

a second elongate guide member extending along the displacement path and positioned in spaced-apart relation to said first elongate guide member;

a first drive pinion mounted to the cartridge access device, said first drive pinion engaging said first elongate gear rack;

a first bearing mounted to the cartridge access device, said first bearing engaging said first elongate guide member;

a second bearing mounted to the cartridge access device, said second bearing engaging said second elongate guide member; and

pinion drive apparatus operatively associated with said first drive pinion, said pinion drive apparatus rotating said first drive pinion to move the cartridge access device along the displacement path.

14. The translation apparatus of claim 13, further comprising:

a second elongate gear rack aligned along said displacement path and positioned in spaced-apart relation to said first elongate gear rack; and

a second drive pinion mounted to the cartridge access device, said second drive pinion engaging said second elongate gear rack.

15. The translation apparatus of claim 14, wherein said second elongate guide member comprises an integral portion of said second elongate gear rack.

16. The translation apparatus of claim 14, wherein said first elongate guide member comprises first and second opposed bearing surfaces and wherein said first bearing mounted to the cartridge access device slidably engages the first and second opposed bearing surfaces of said first elongate guide member.

17. The translation apparatus of claim 16, wherein said second elongate guide member comprises first and second opposed bearing surfaces and wherein said second bearing mounted to the cartridge access device slidably engages the first and second opposed bearing surfaces of said second elongate guide member.

18. The translation apparatus of claim 17, further comprising a third bearing mounted to the cartridge access device, said third bearing contacting said first elongate gear rack and allowing the cartridge access device to move along the displacement path.

19. The translation apparatus of claim 18, wherein said third bearing comprises a wheel.

20. The translation apparatus of claim 18, further comprising:

a third elongate gear rack positioned in generally parallel, spaced-apart relation to said first elongate gear rack; and

a fourth elongate gear rack positioned in generally parallel, spaced-apart relation to said second elongate gear rack so that said first, second, third, and fourth elongate gear racks define a generally rectangular, parallelopiped configuration with said first and third elongate gear racks defining a bottom side of the generally rectangular, parallelopiped configuration and said second and fourth elongate gear racks defining a top side of the generally rectangular, parallelopiped configuration.

21. The translation apparatus of claim 20, further comprising:

a third drive pinion mounted to the cartridge access device and operatively associated with said pinion drive apparatus, said third drive pinion engaging said third elongate gear rack; and

a fourth drive pinion mounted to the cartridge access device and operatively associated

with said pinion drive apparatus, said fourth drive pinion engaging said fourth elongate gear rack.

22. The translation apparatus of claim 21, further comprising:

a fifth elongate gear rack having a first end and a second end, the first end of said fifth elongate gear rack being mounted adjacent the second end of said first elongate gear rack so that said fifth elongate gear rack is aligned along the displacement path; and

a sixth elongate gear rack having a first end and a second end, the first end of said sixth elongate gear rack being mounted adjacent the second end of said second elongate gear rack so that said sixth elongate gear rack is aligned along the displacement path.

23. The translation apparatus of claim 22, further comprising:

a seventh elongate gear rack having a first end and a second end, the first end of said seventh elongate gear rack being mounted adjacent the second end of said third elongate gear rack so that said seventh elongate gear rack is aligned along the displacement path; and

an eighth elongate gear rack having a first end and a second end, the first end of said eighth elongate gear rack being mounted adjacent the second end of said fourth elongate gear rack so that said eighth elongate gear rack is aligned along the displacement path.

24. Translation apparatus for moving a cartridge access device along a displacement path, comprising:

an elongate gear rack aligned along the displacement path;

guide means integral with said elongate gear rack for guiding the cartridge access device along the displacement path;

a drive pinion mounted to the cartridge access device, said drive pinion engaging said elongate gear rack; and

pinion drive means operatively associated with said drive pinion for rotating said first drive pinion to move the cartridge access device along the displacement path.

APPENDIX B

Reference Relied on By Examiner in his Final Response.

A copy of the following reference is attached hereto for the Board's convenience:

Tadokoro, *et al.*, U.S. Patent No. 6,116,877, issued December 26, 2000, entitled "Cassette Auto Changer System Including Tape Signal Reading Means and Selection Means for Selecting Between a Plurality of Cassettes."

US006166877A

United States Patent [19]

Tadokoro et al.

[11] Patent Number: 6,166,877

[45] Date of Patent: *Dec. 26, 2000

[54] CASSETTE AUTO CHANGER SYSTEM INCLUDING TAPE SIGNAL READING MEANS AND SELECTION MEANS FOR SELECTING BETWEEN A PLURALITY OF CASSETTES

[75] Inventors: Keiji Tadokoro; Noriyuki Yamazaki; Junichi Saiki; Hideaki Noguchi; Nobuhiro Tsurumaki, all of Kanagawa; Takao Mokutani, Shizuoka; Toru Yumine; Koichi Aikawa, both of Kanagawa, all of Japan

[73] Assignee: Sony Corporation, Tokyo, Japan

[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

[21] Appl. No.: 08/770,178

[22] Filed: Dec. 19, 1996

[30] Foreign Application Priority Data

Dec. 19, 1995 [JP] Japan 7-330829

[51] Int. Cl.[7] G11B 15/68

[52] U.S. Cl. 360/92

[58] Field of Search 360/92; 369/32, 369/34, 36, 178, 191–192

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Primary Examiner—Brian E. Miller

Attorney, Agent, or Firm—Frommer Lawrence & Haug, LLP; William S. Frommer; Matthew K. Ryan

[57] ABSTRACT

A cassette auto changer system including a tape signal reading member and a selection member for selecting between a plurality of cassettes. The cassette auto changer includes a base console including a port for tape insertion or extraction operations and having a tape insert compartment. The base console has upper and lower guide rails. A drive console mounts the tape signal reading member and a cassette console mounts a plurality of compartments for storing the tape cassettes. A tape transfer member transports the tape cassettes selectively between the base console, the drive console and the cassette console. An electrically conductive rail is disposed proximate to the guide rails which is powered by enclosed electrical wiring circuitry. In addition, an unmagnetized cassette shuttle body of the tape transfer member is driven along the electrically conductive rail and is guided along the guide rails. Electrical current is input to the tape transfer member form the electrically conductive rail via the cassette shuttle body.

27 Claims, 81 Drawing Sheets

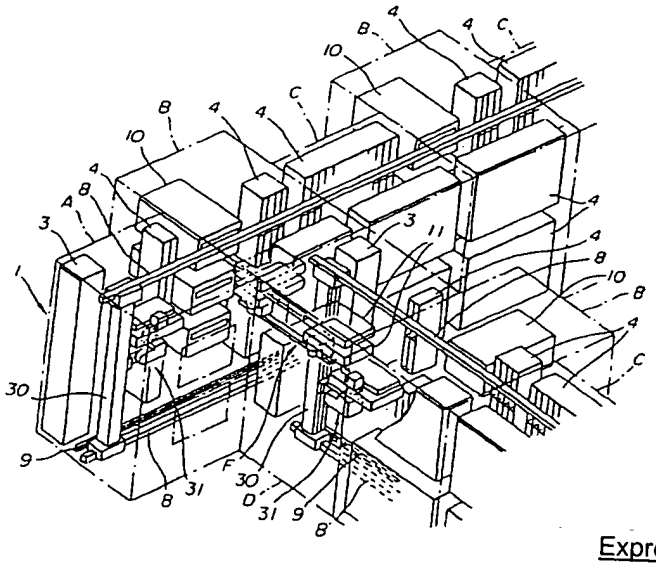

FIG.1

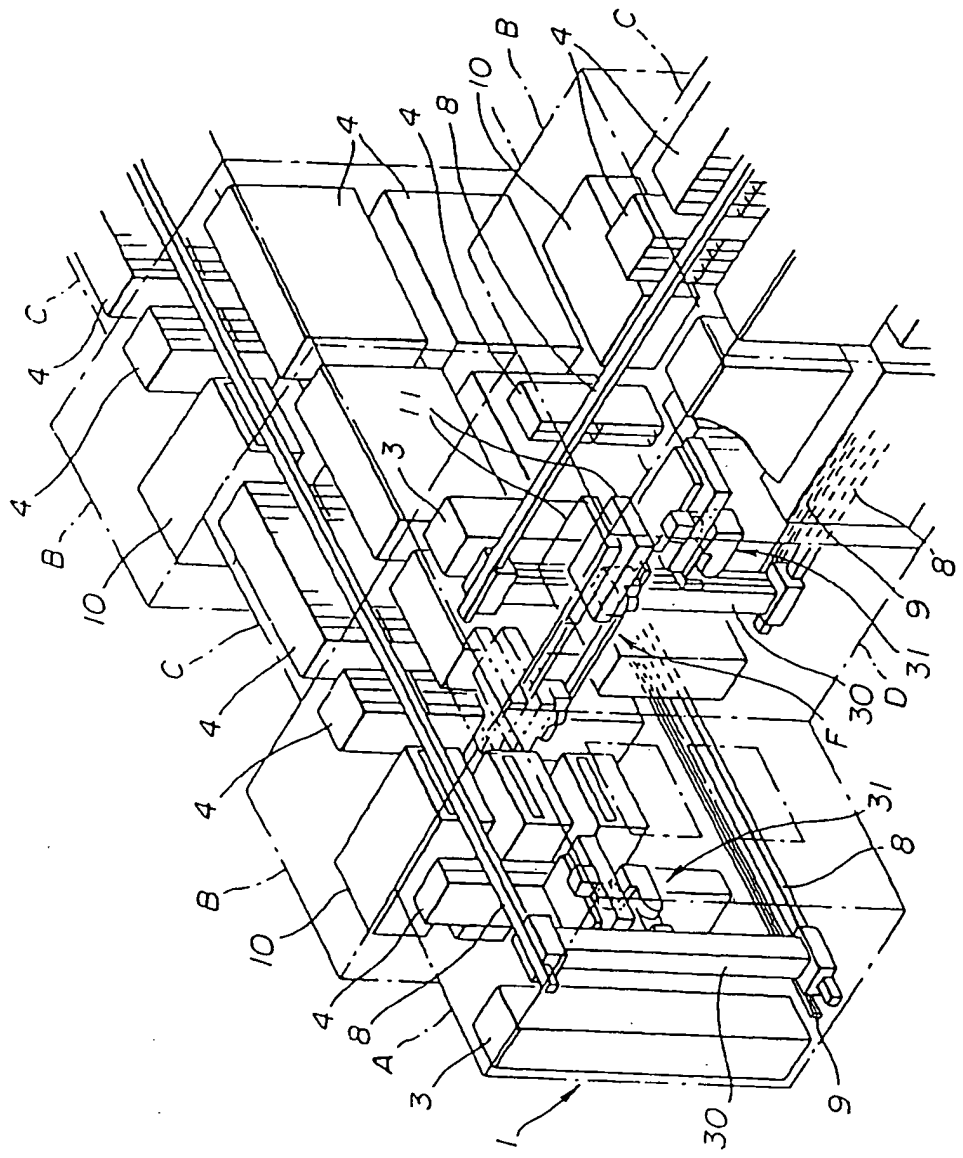

FIG.2A

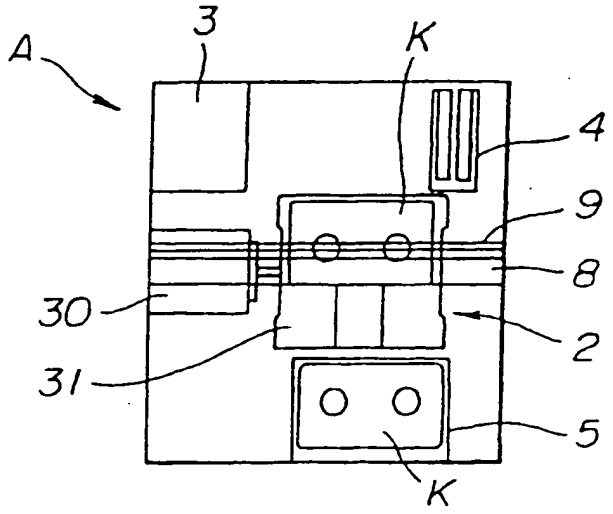

FIG.2B

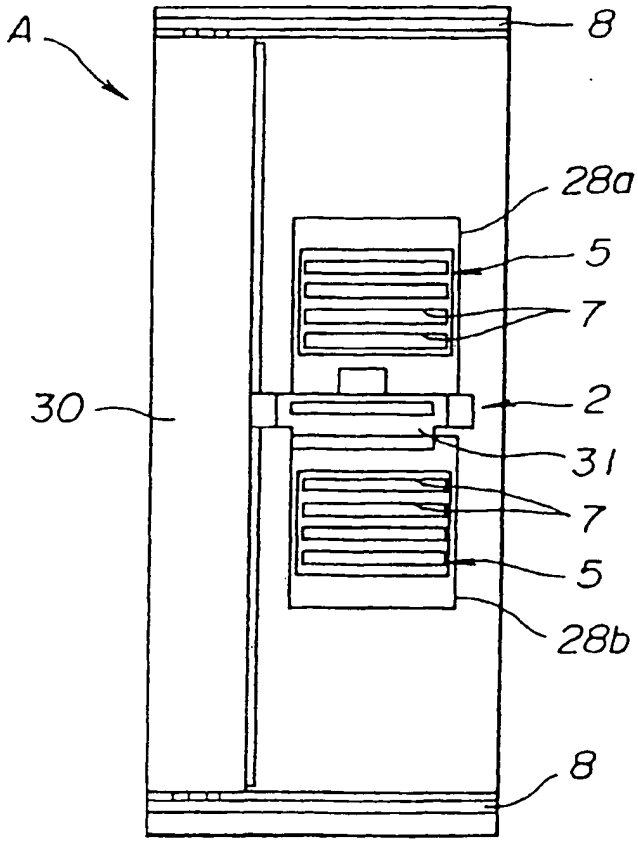

FIG.3A

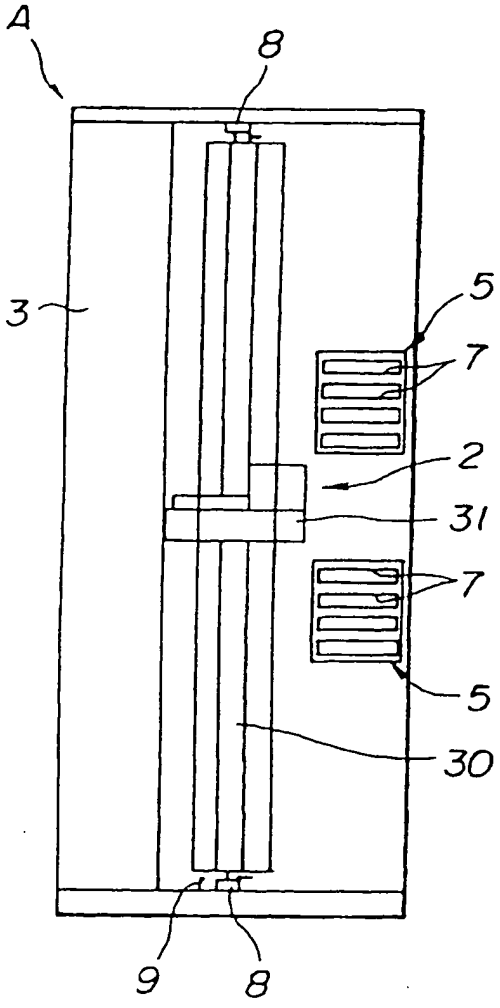

FIG.3B

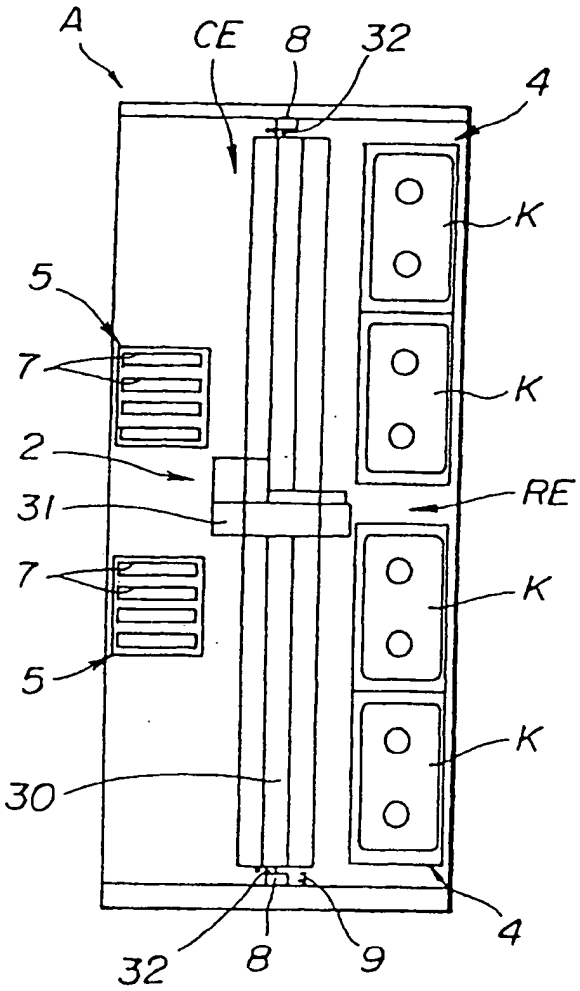

FIG.4A

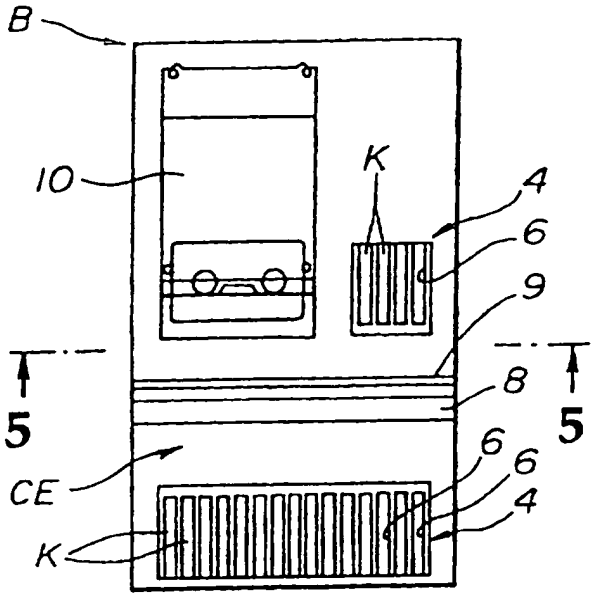

FIG.4B

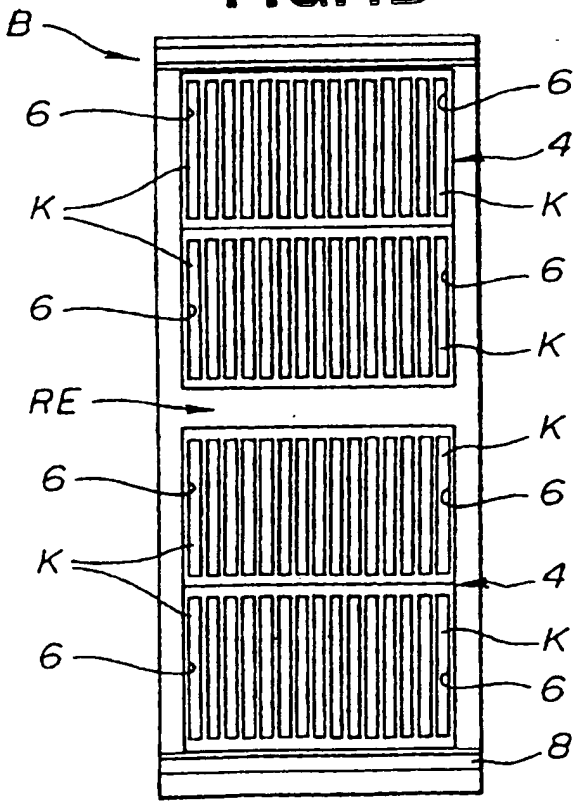

FIG.5A

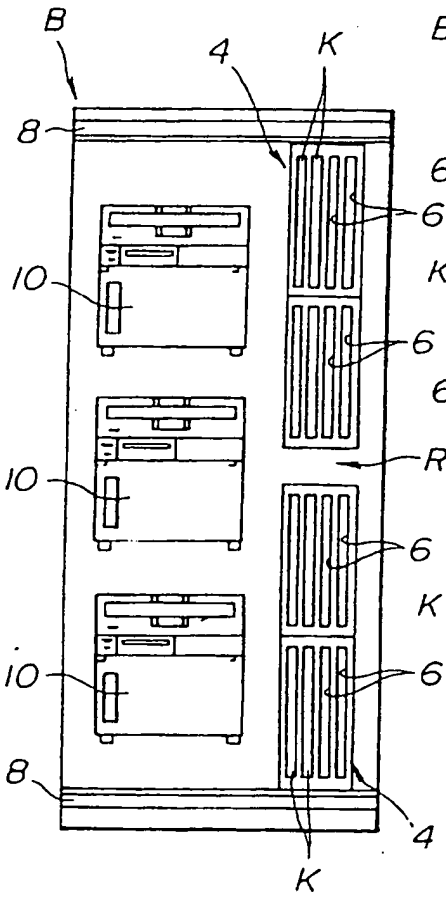
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FIG.5B

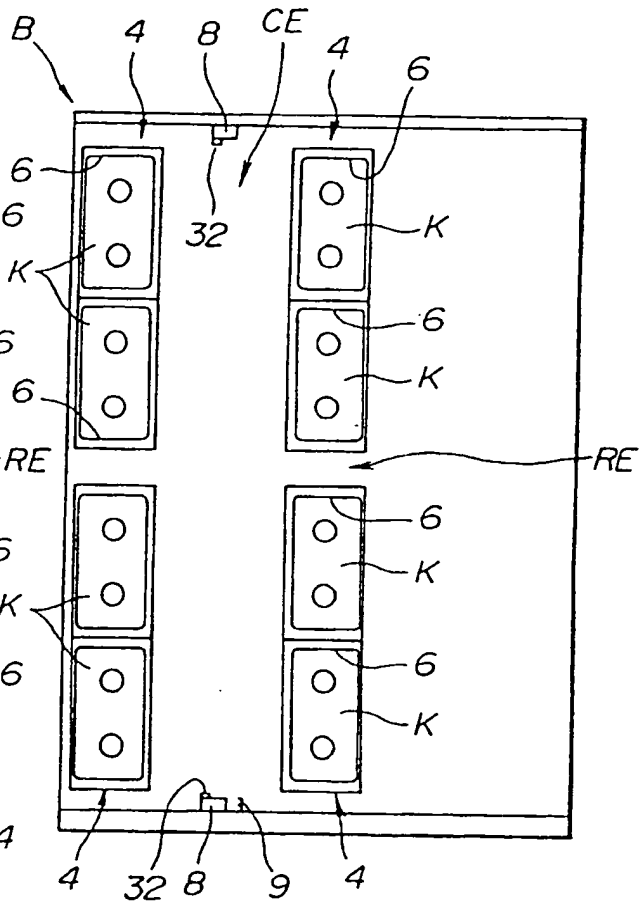
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FIG.6A

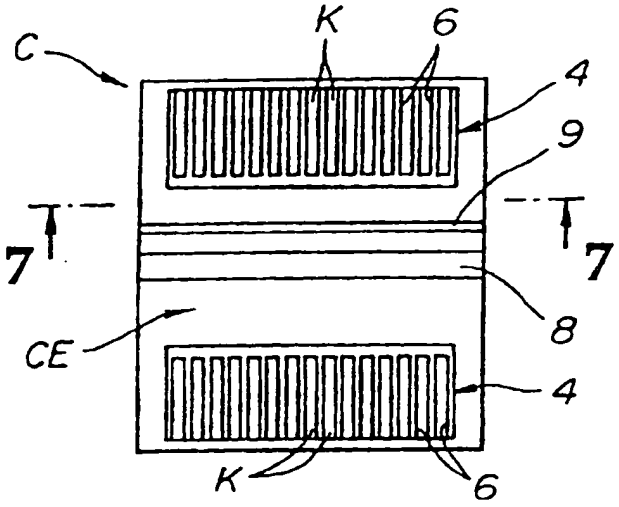

FIG.6B

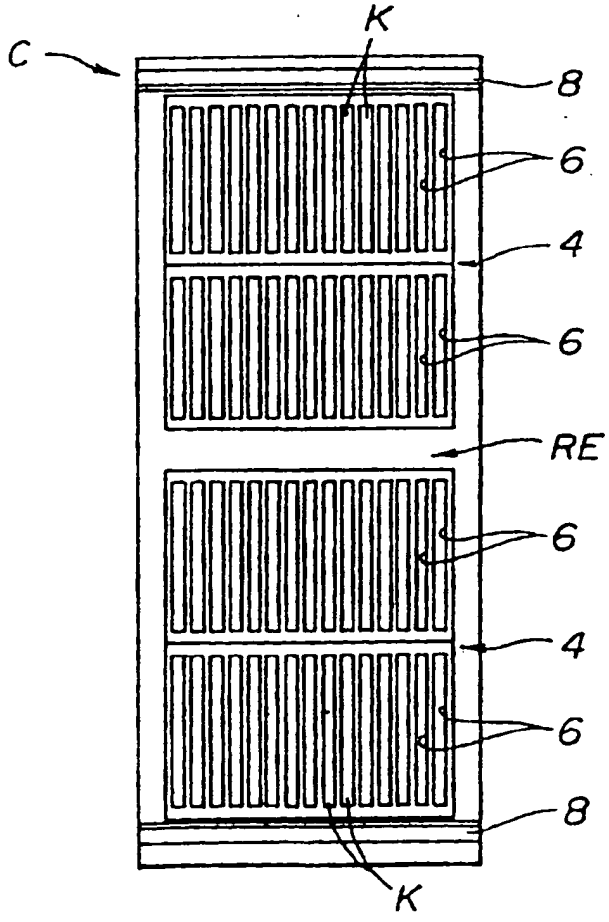

FIG.7A

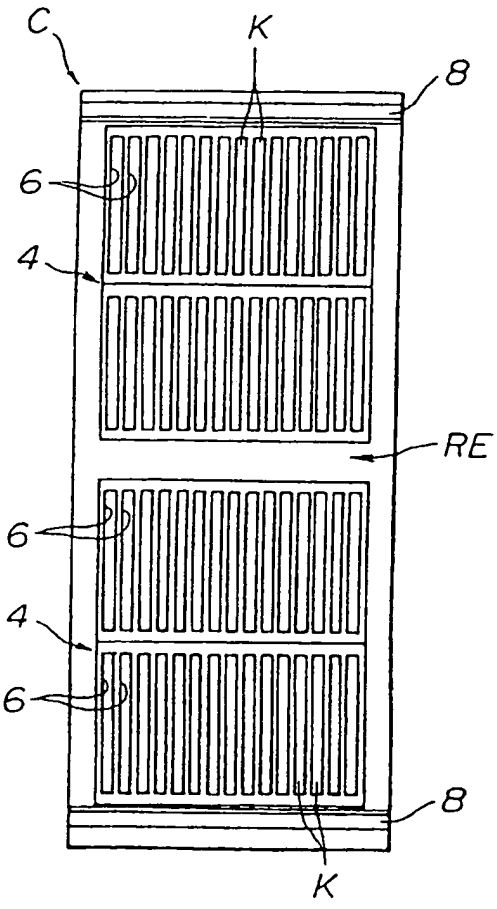

FIG.7B

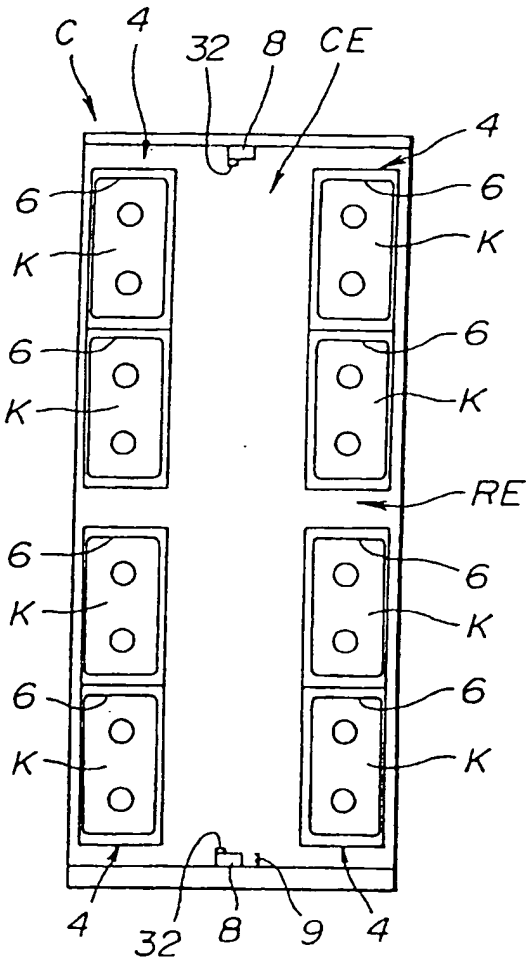

FIG.8A

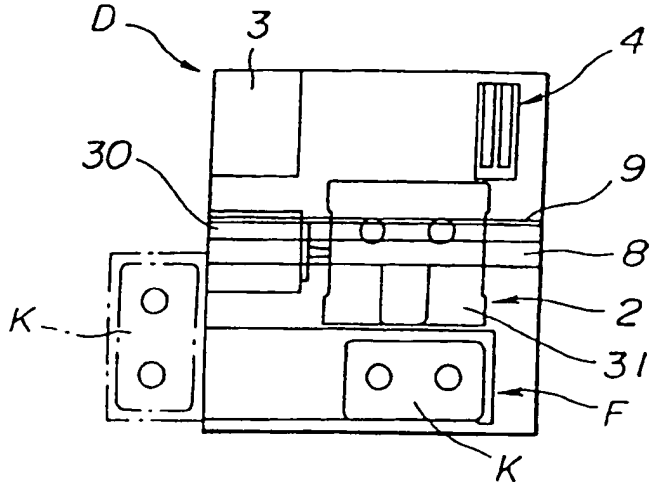

FIG.8B

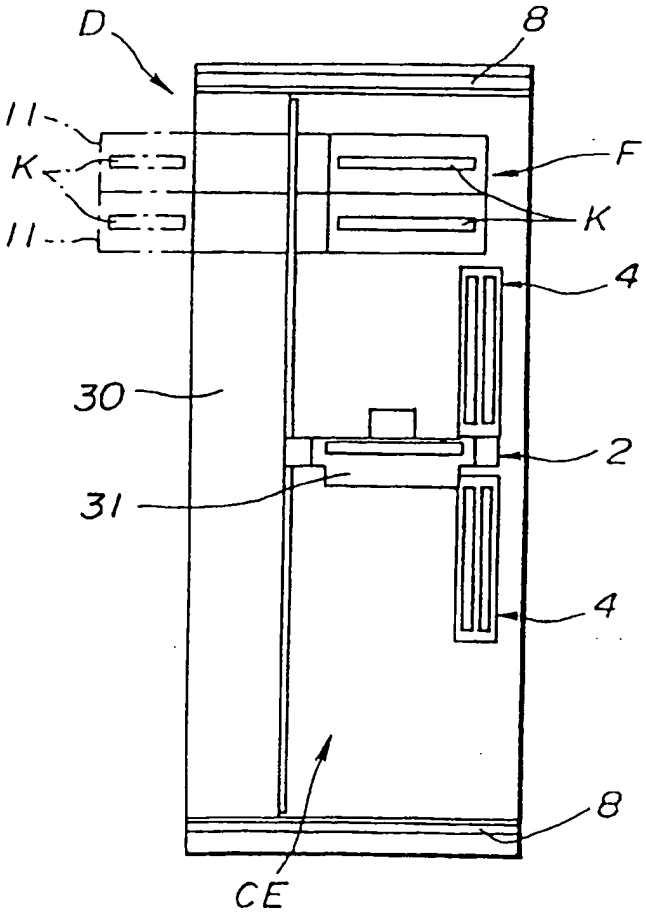

FIG.9A

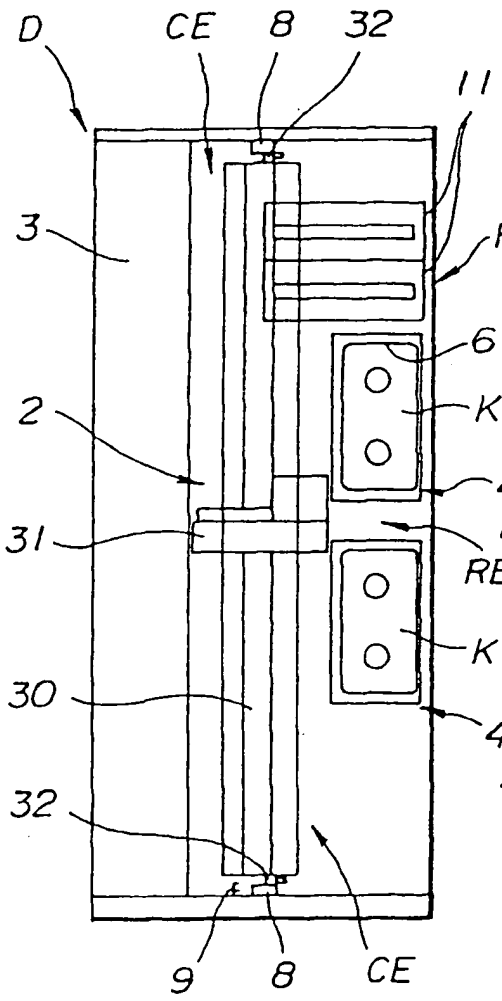
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FIG.9B

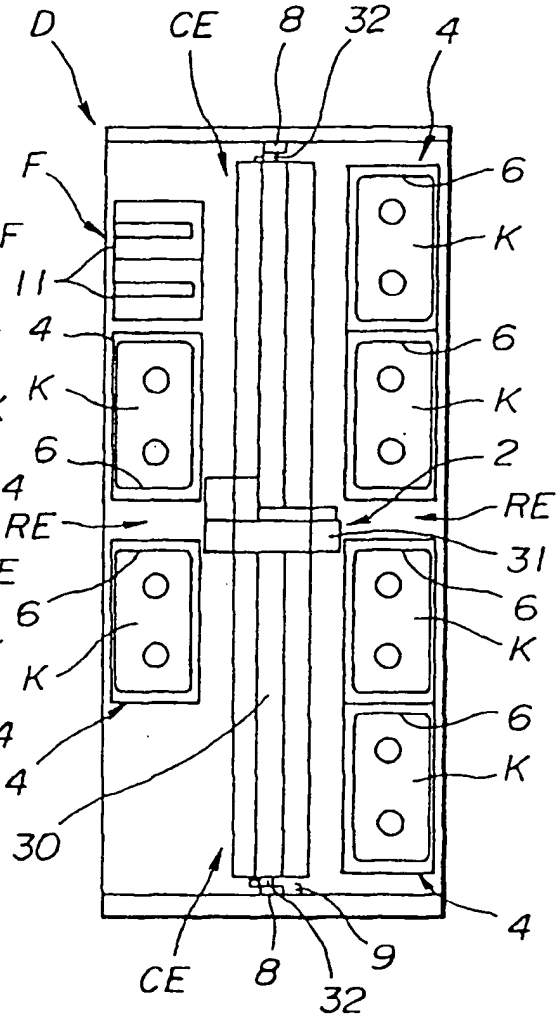
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FIG.10

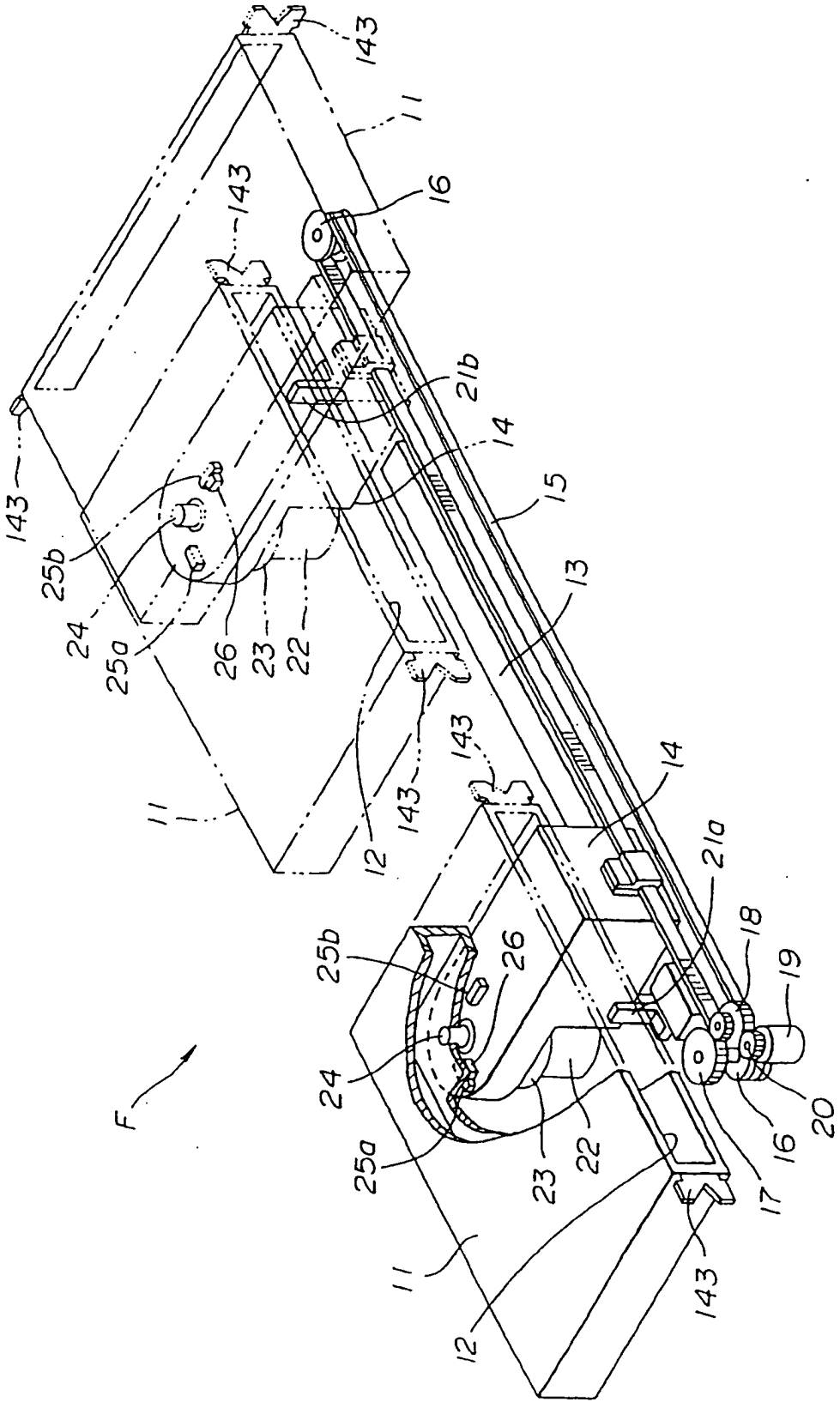
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FIG.11

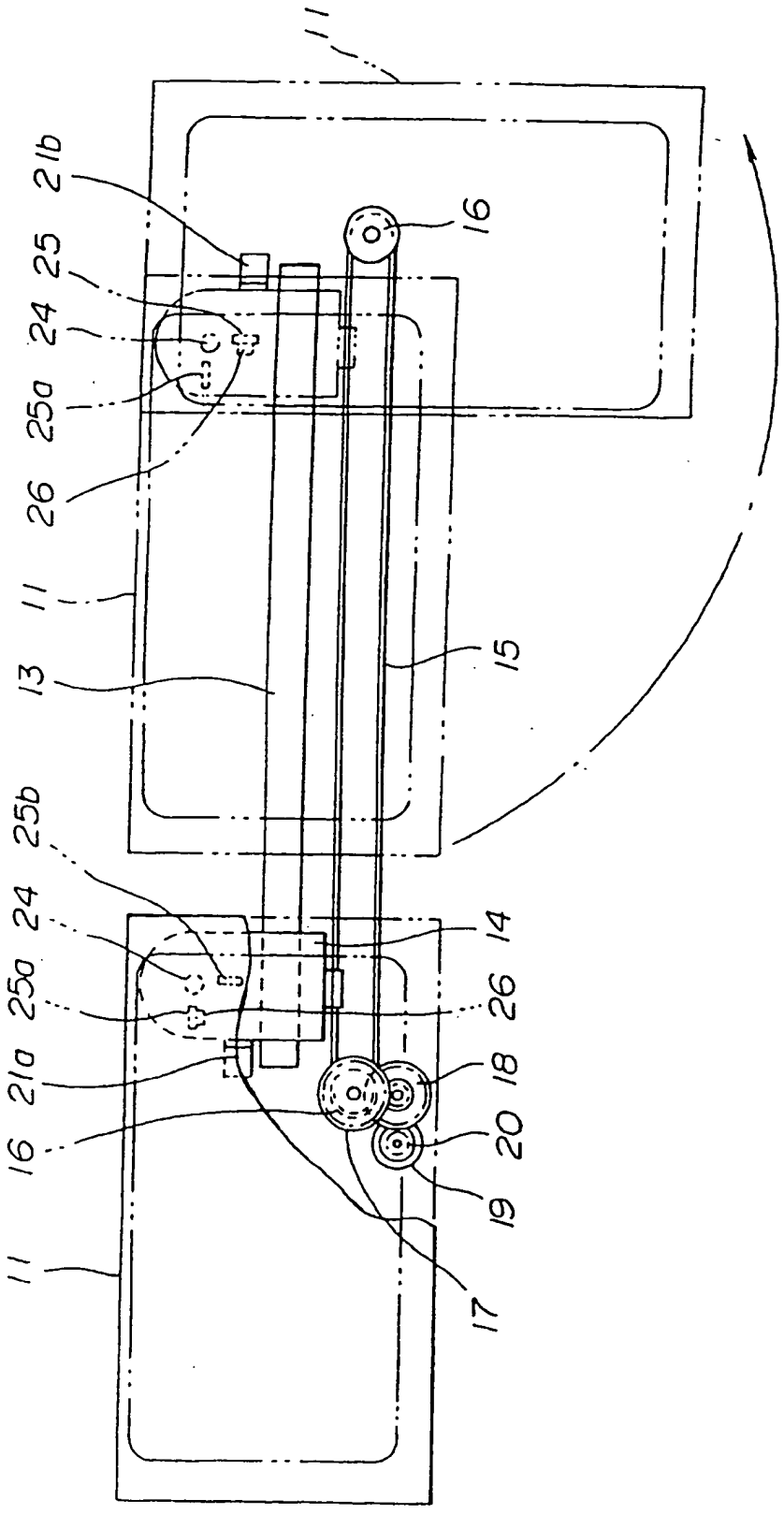

FIG.12A

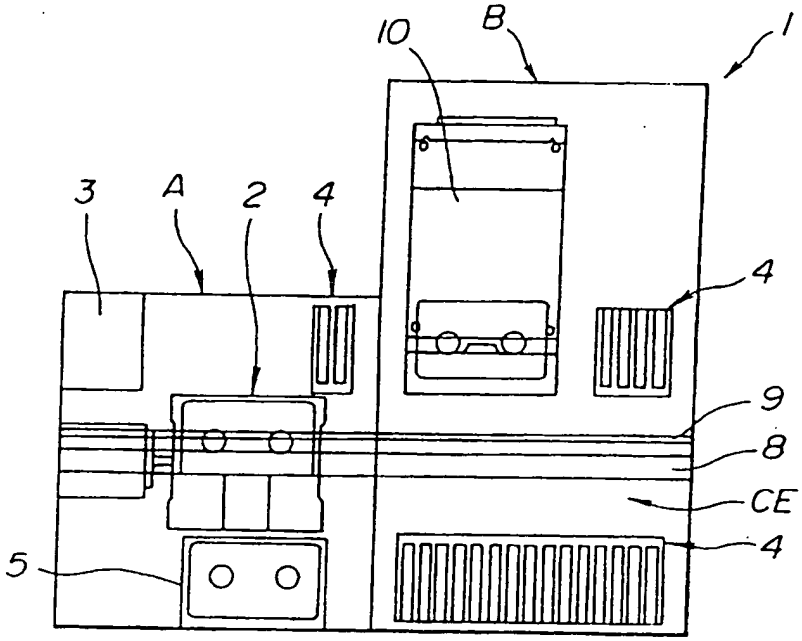

FIG.12B

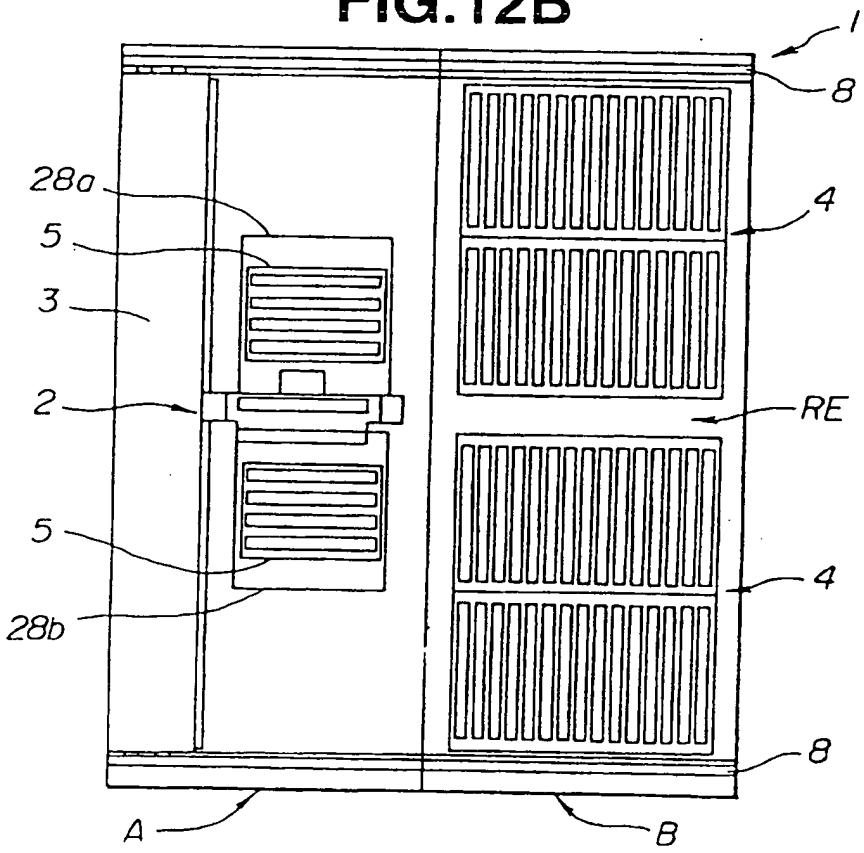

FIG.13

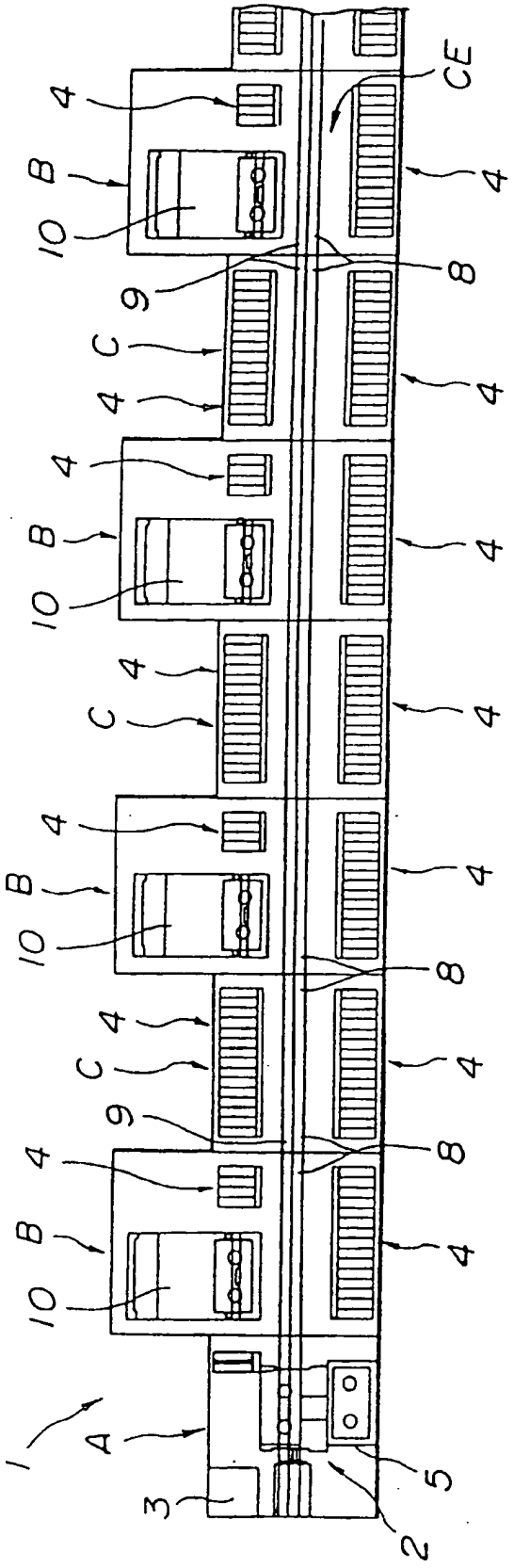

FIG.14

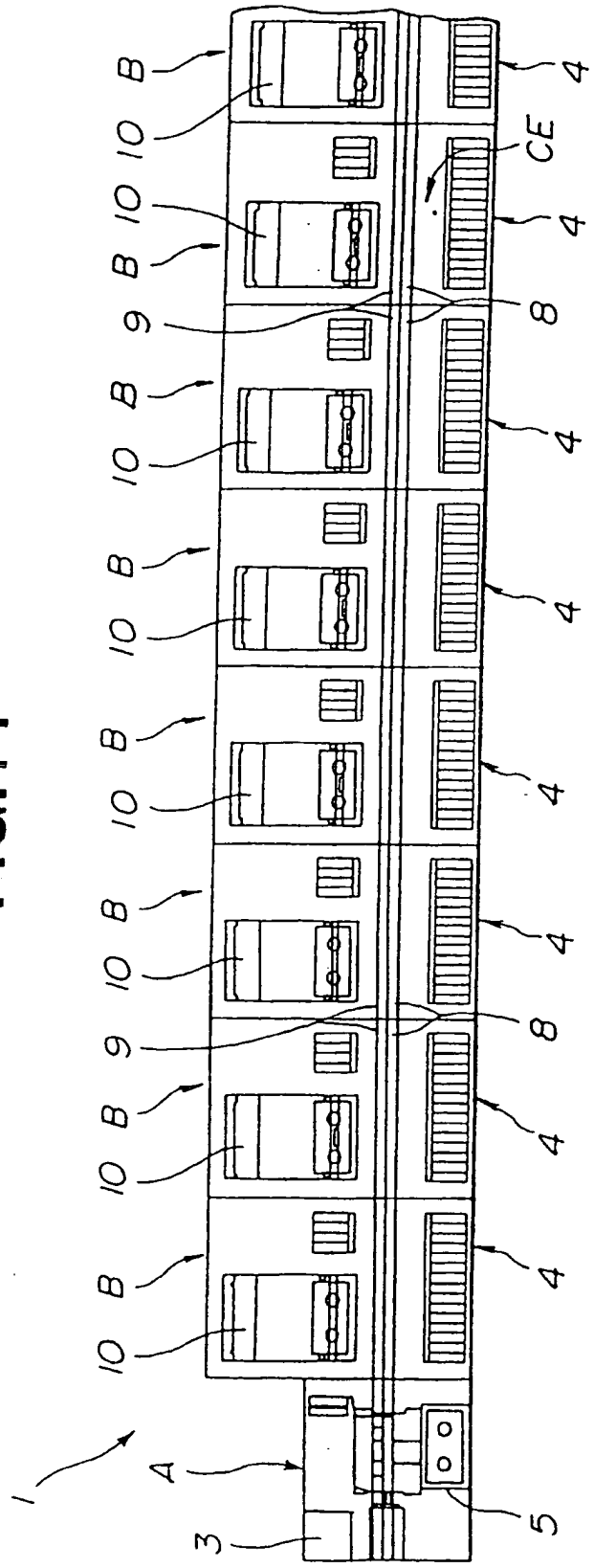

FIG.15

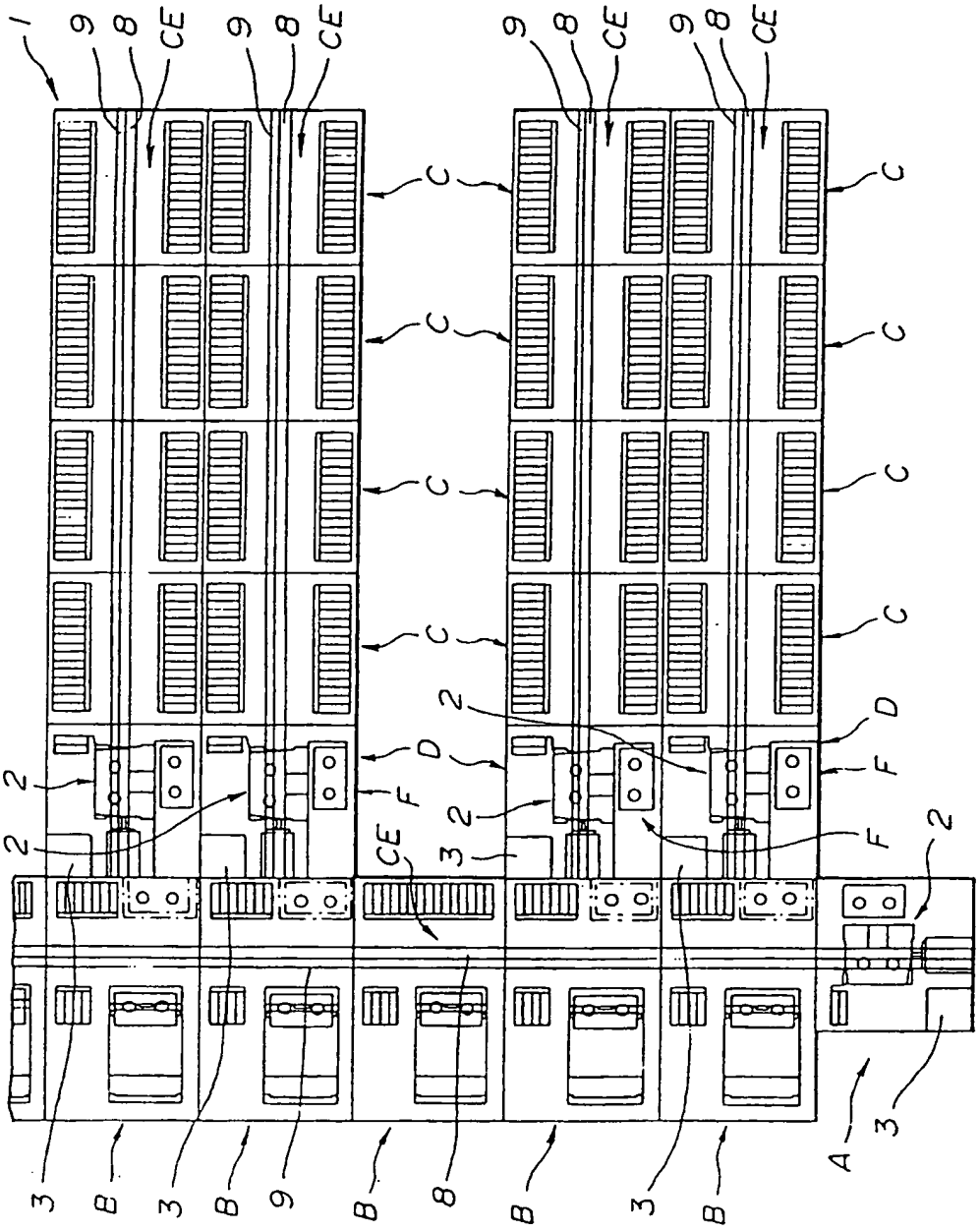

FIG.16

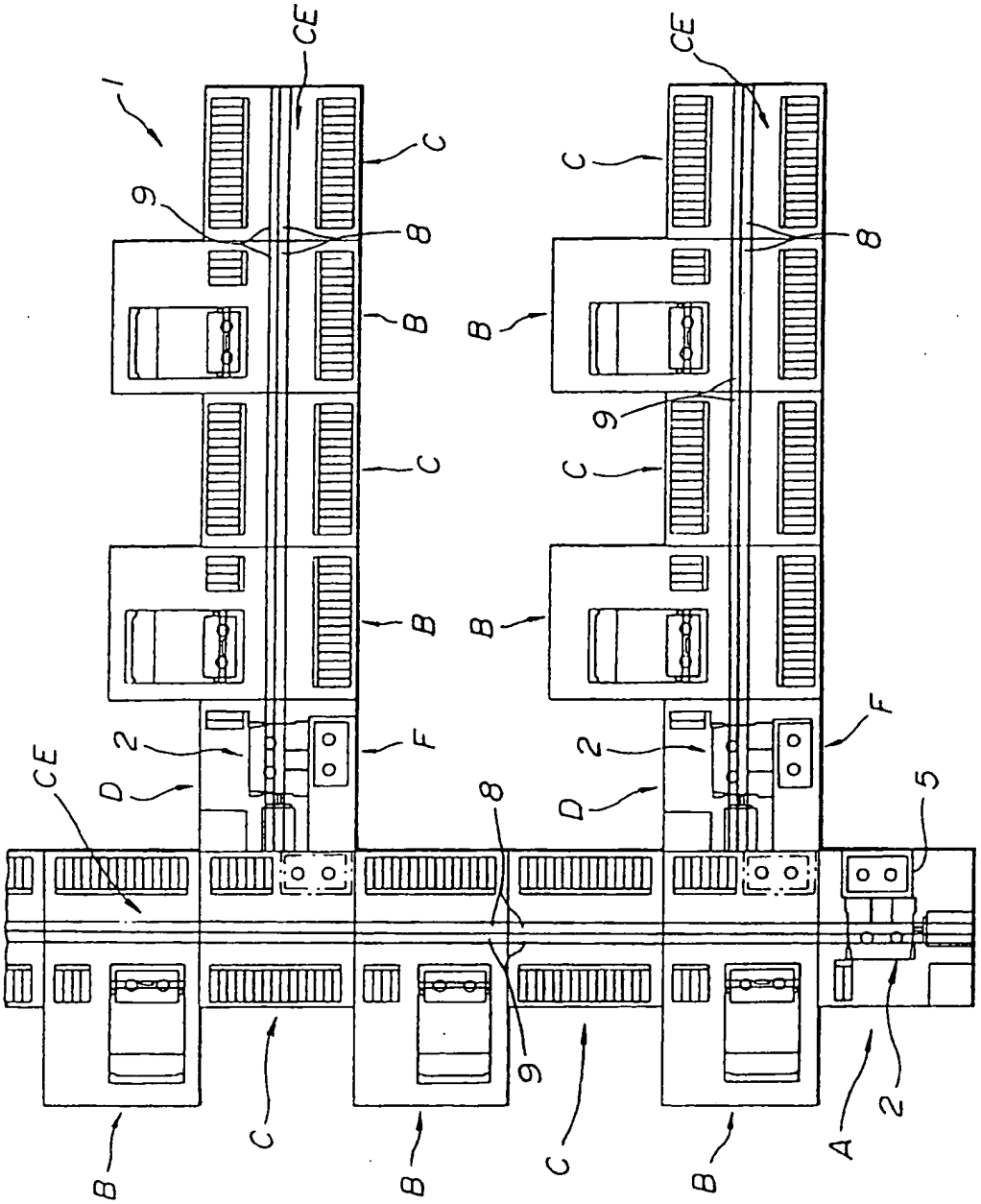

FIG.17

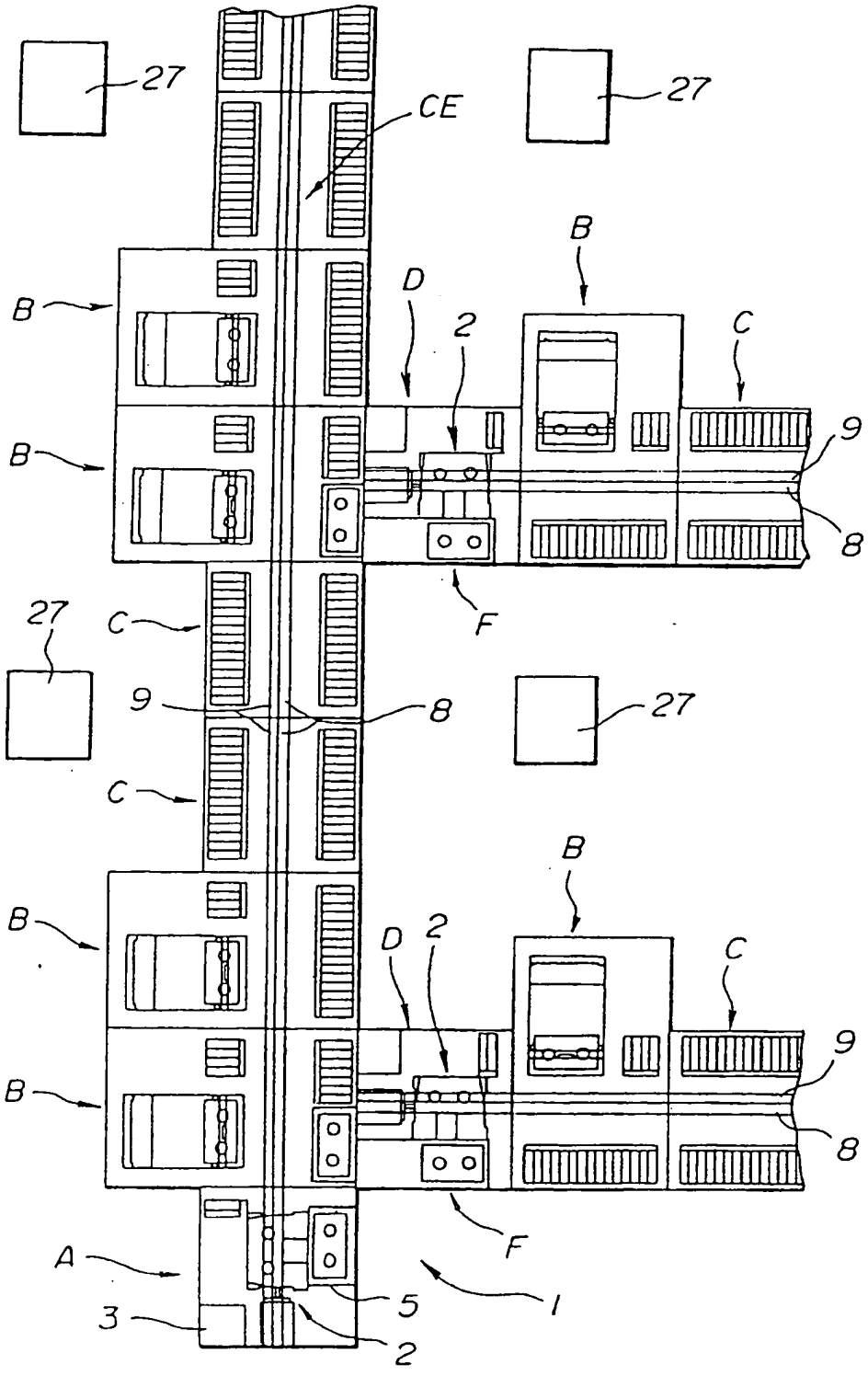

FIG.18

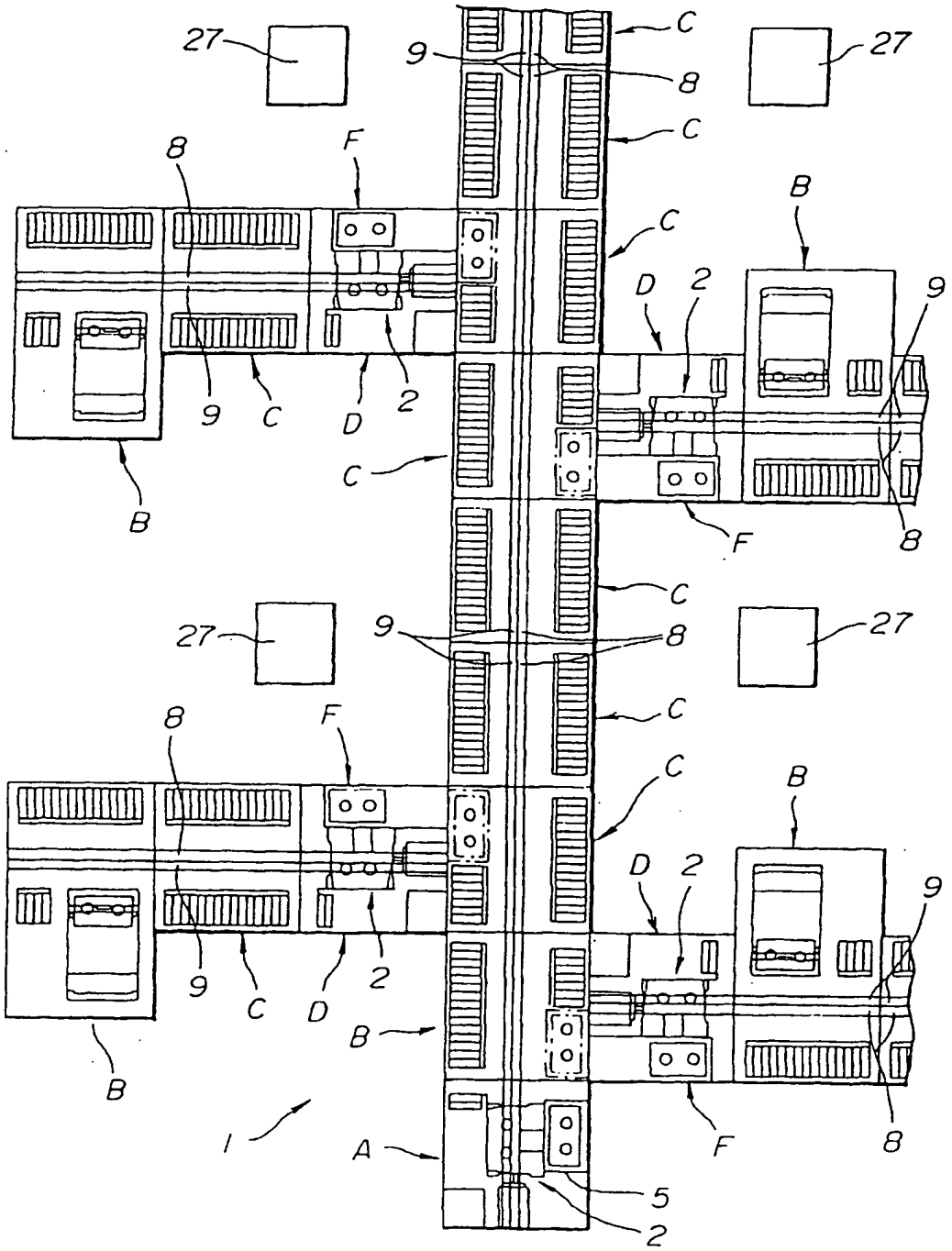
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FIG.19

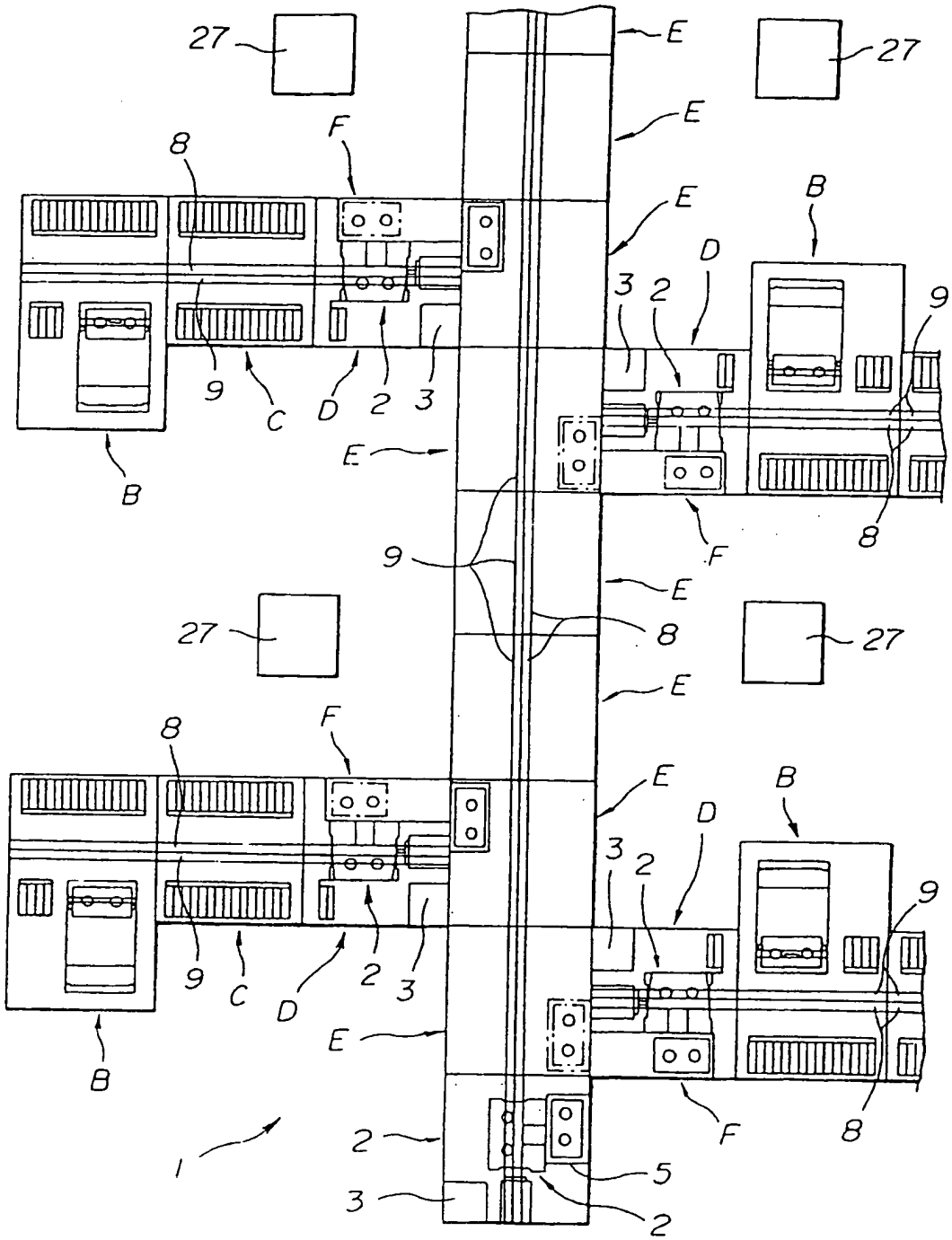
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FIG.20

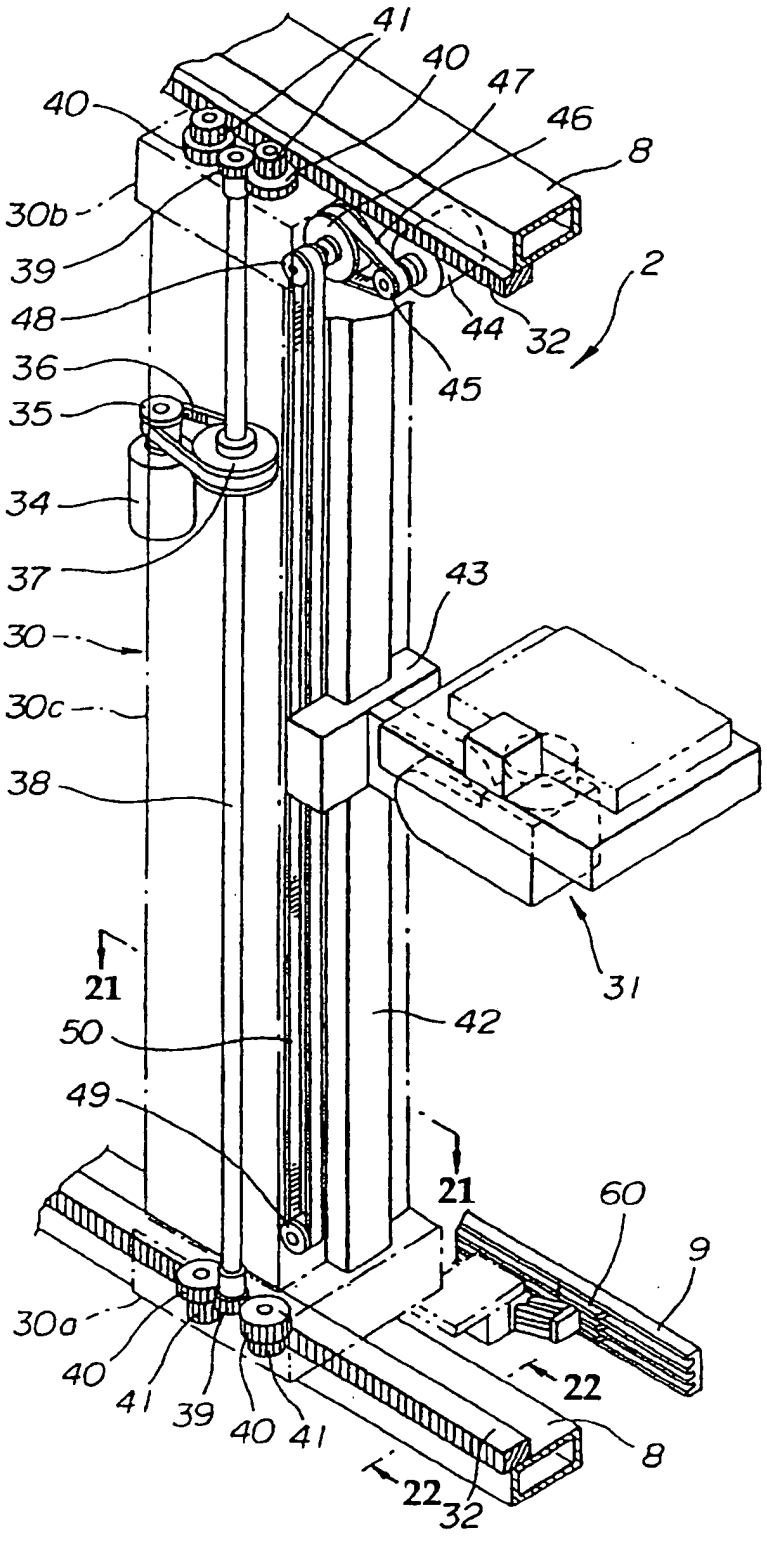
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FIG.21

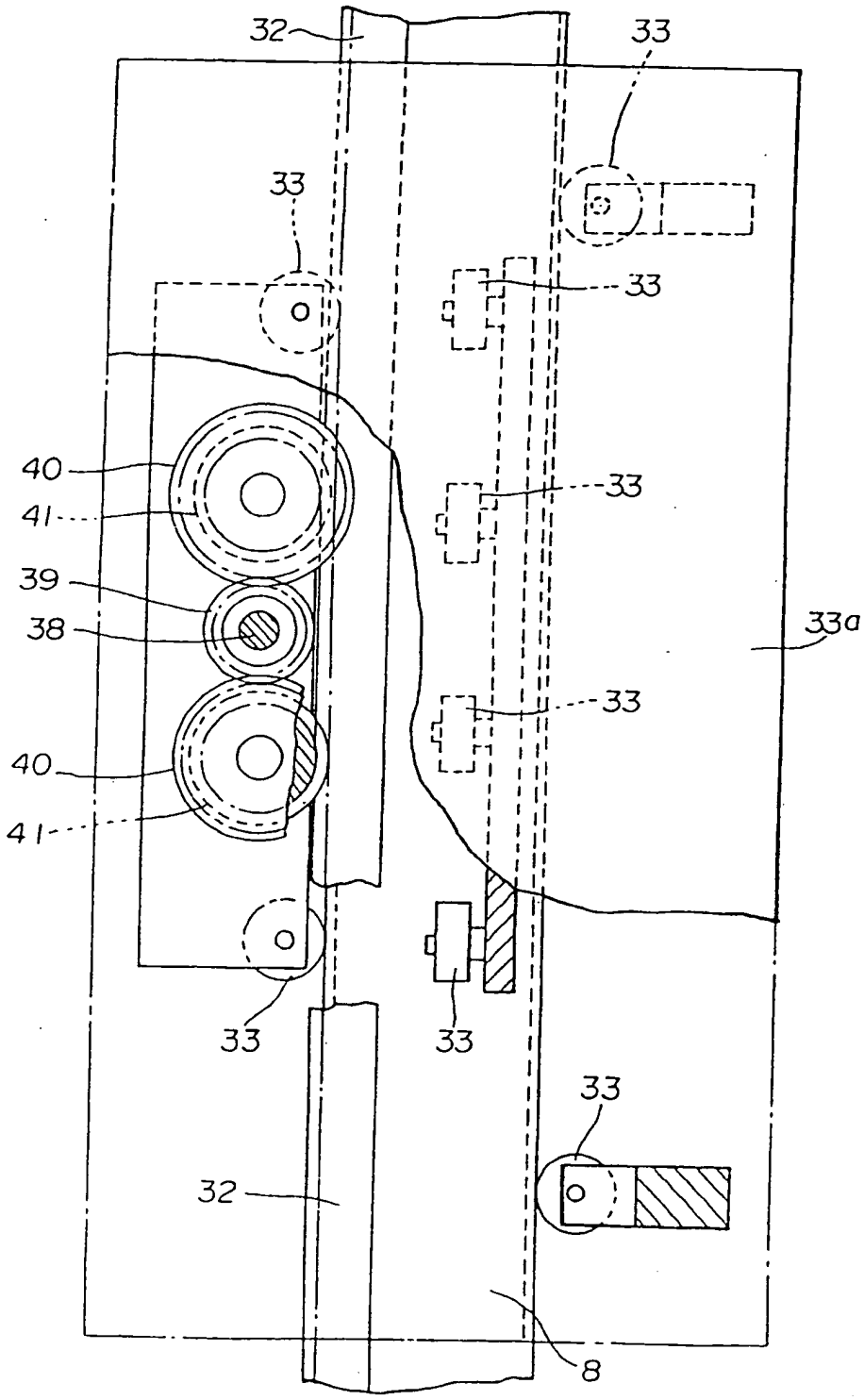

FIG.22

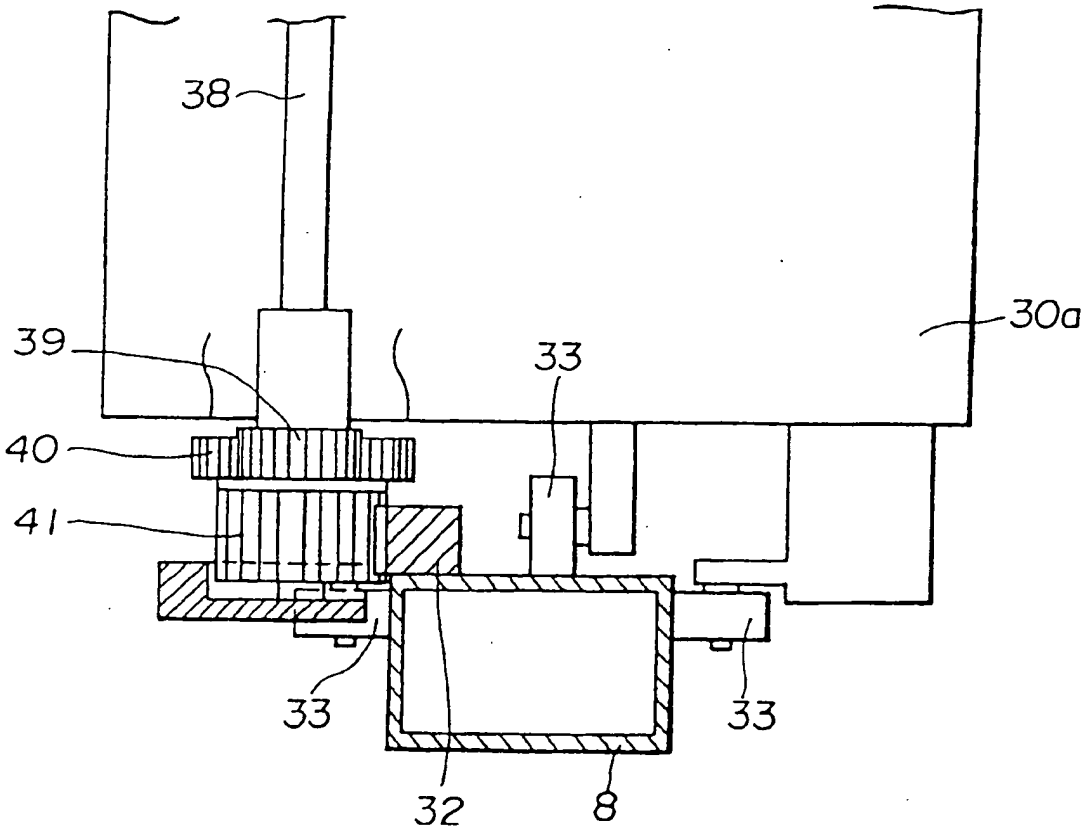

FIG.23

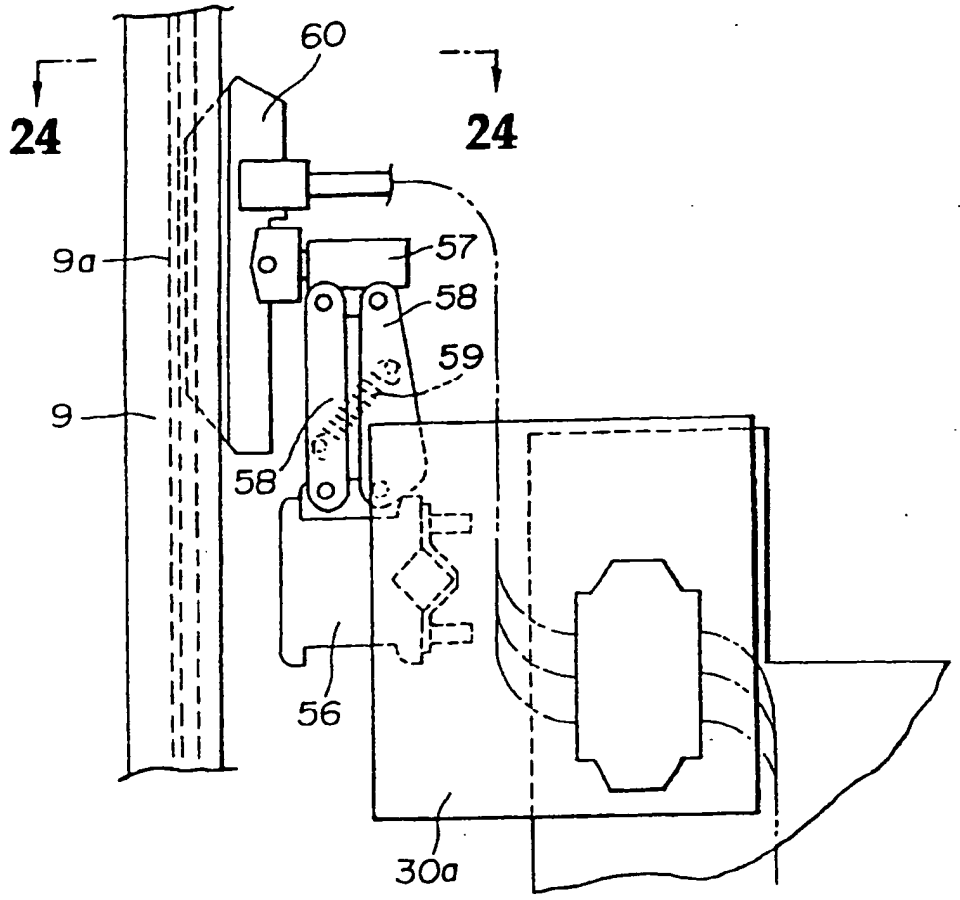

FIG.24

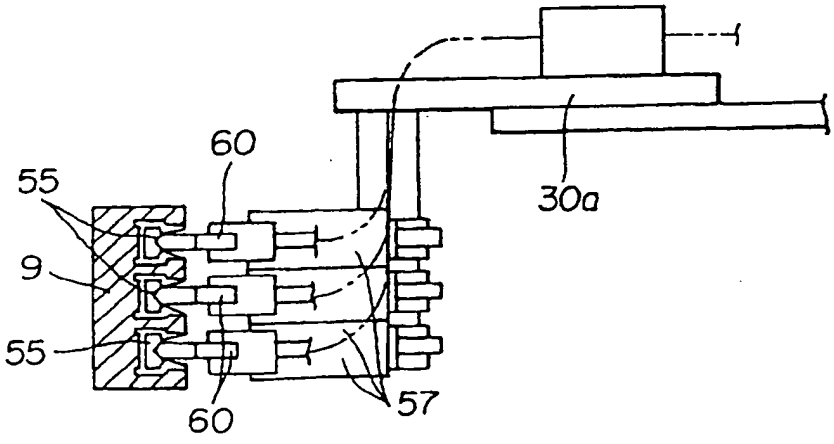

FIG.25

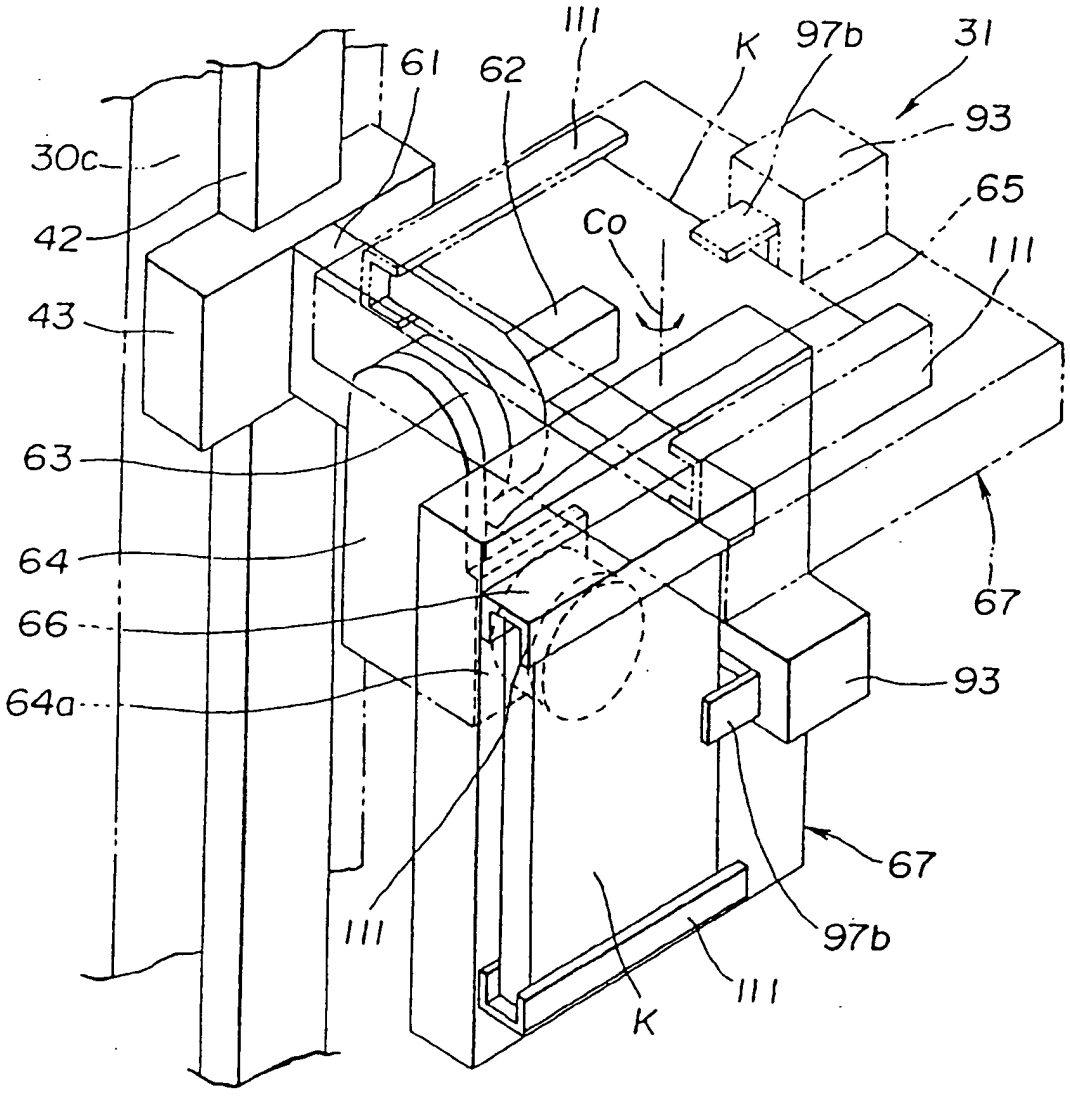
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FIG.26

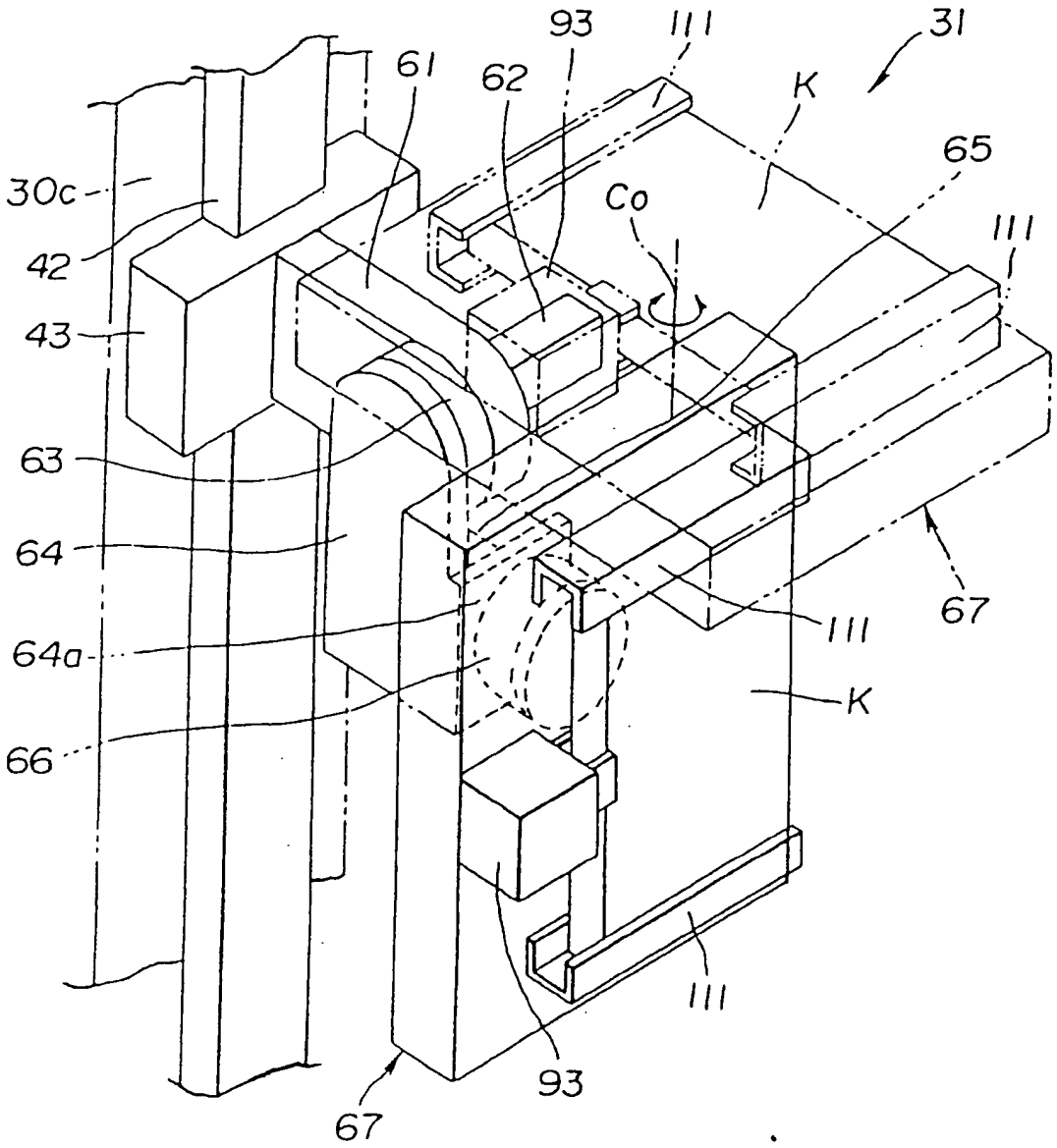


FIG.27

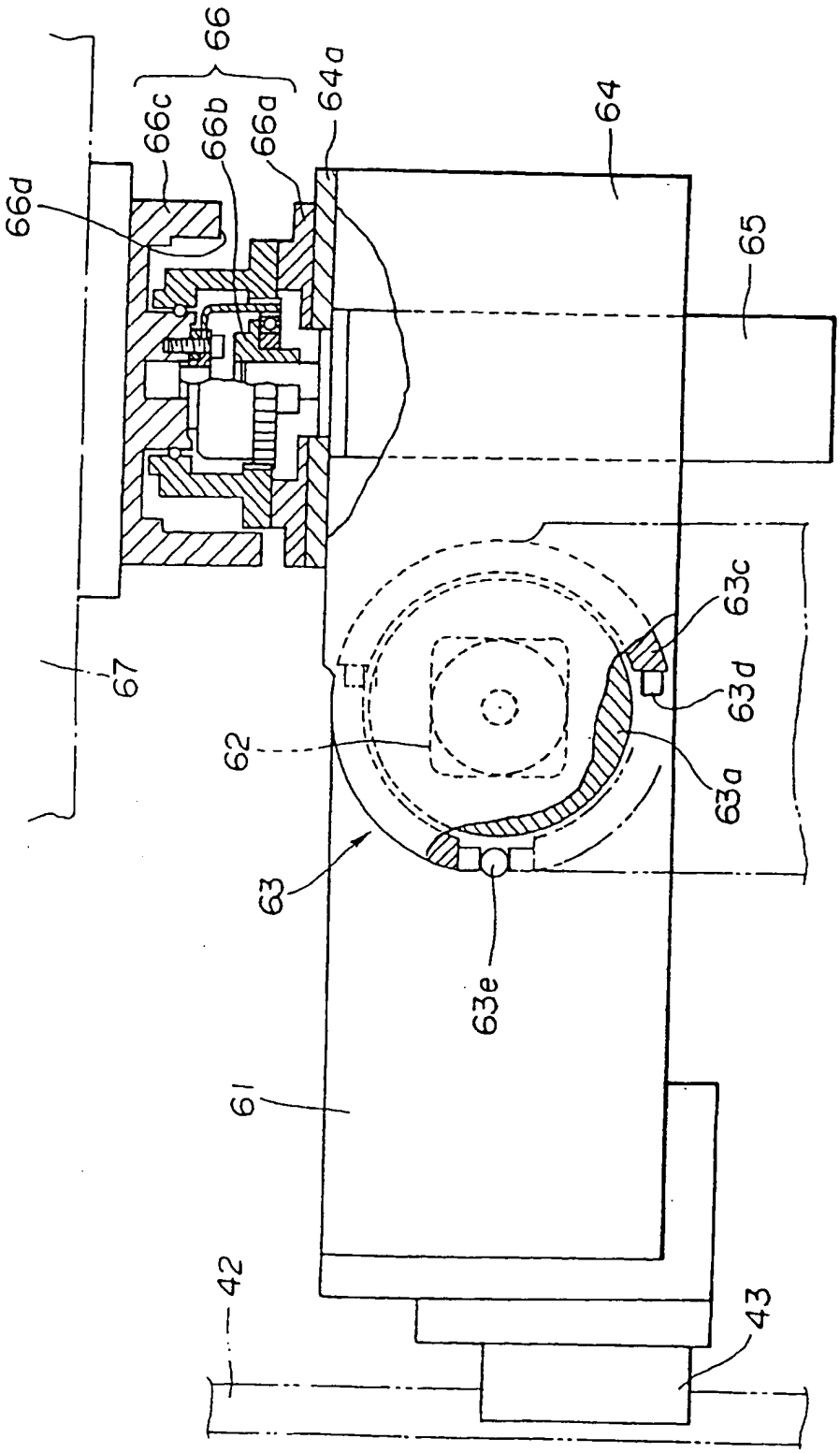


FIG.28

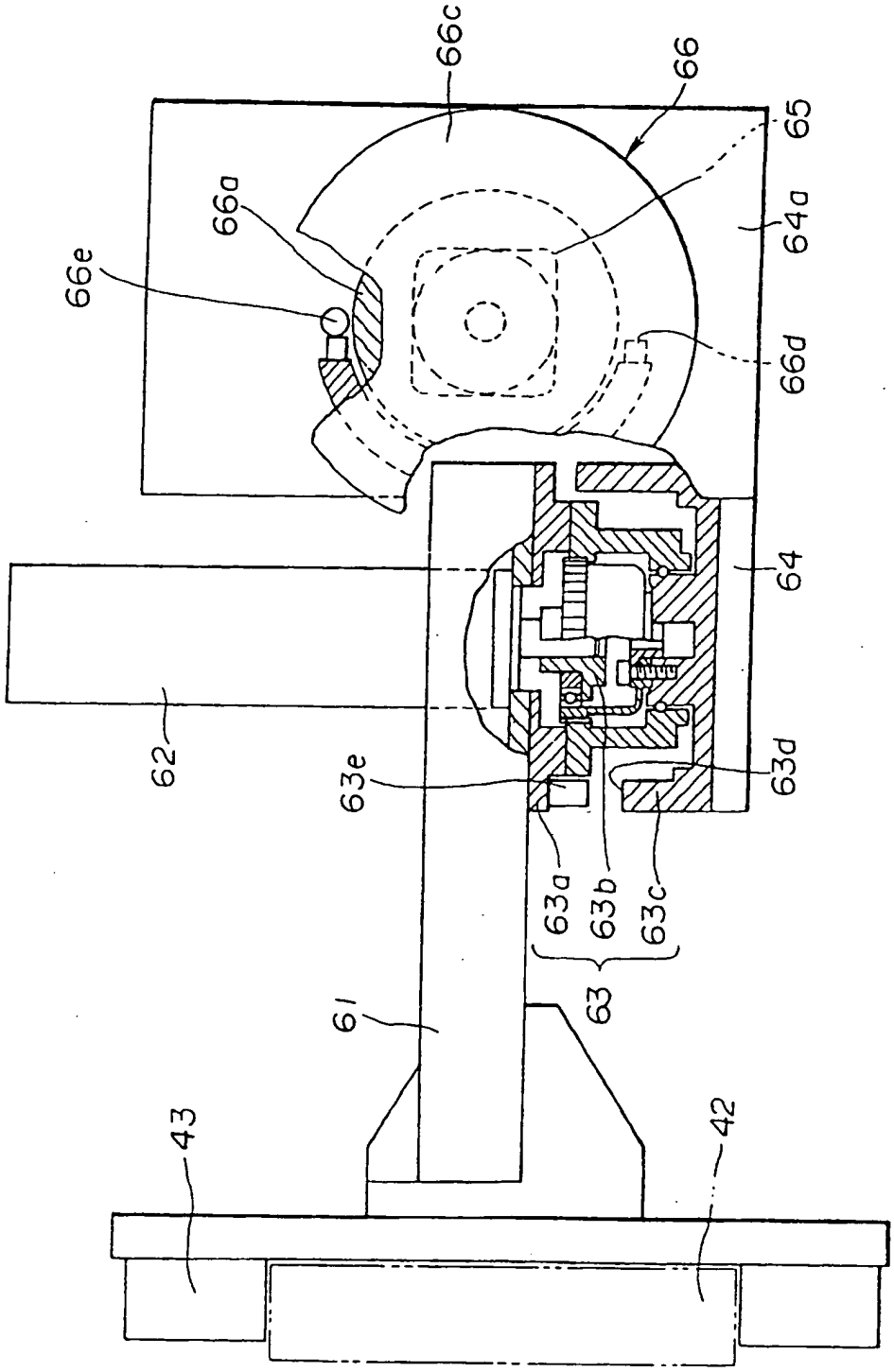


FIG.29

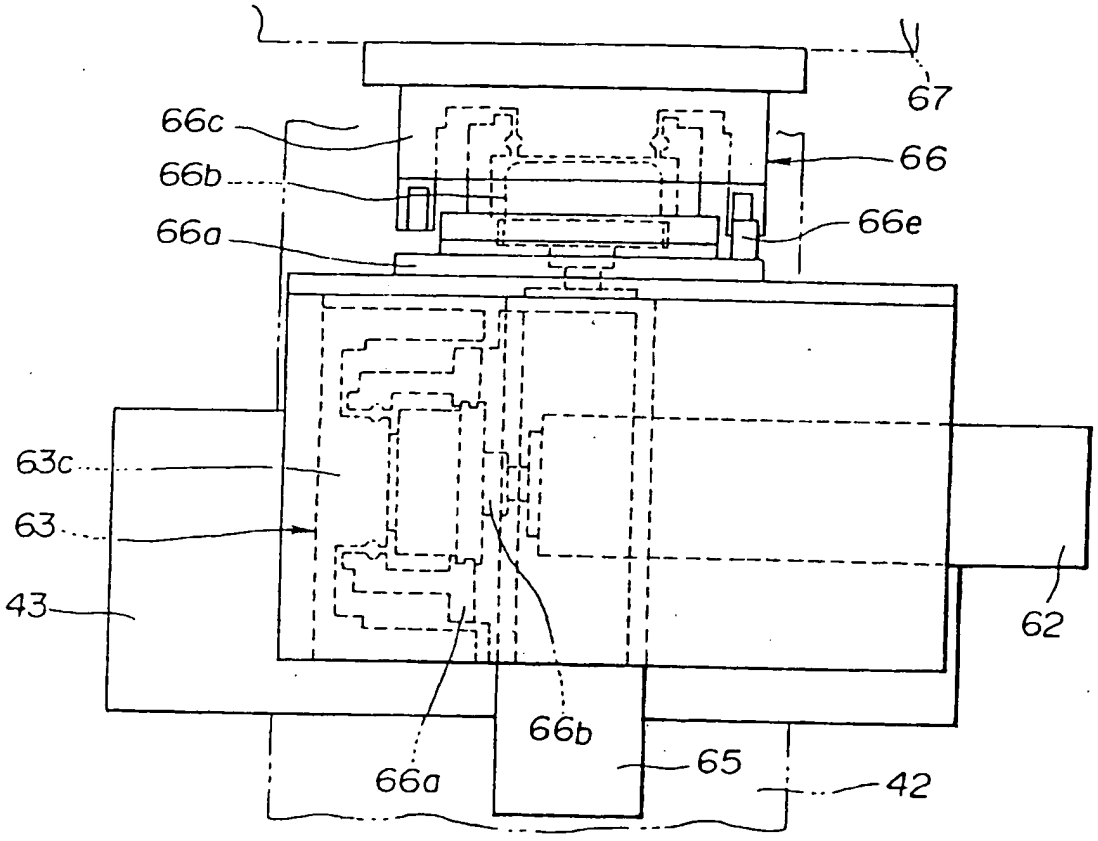


FIG.30

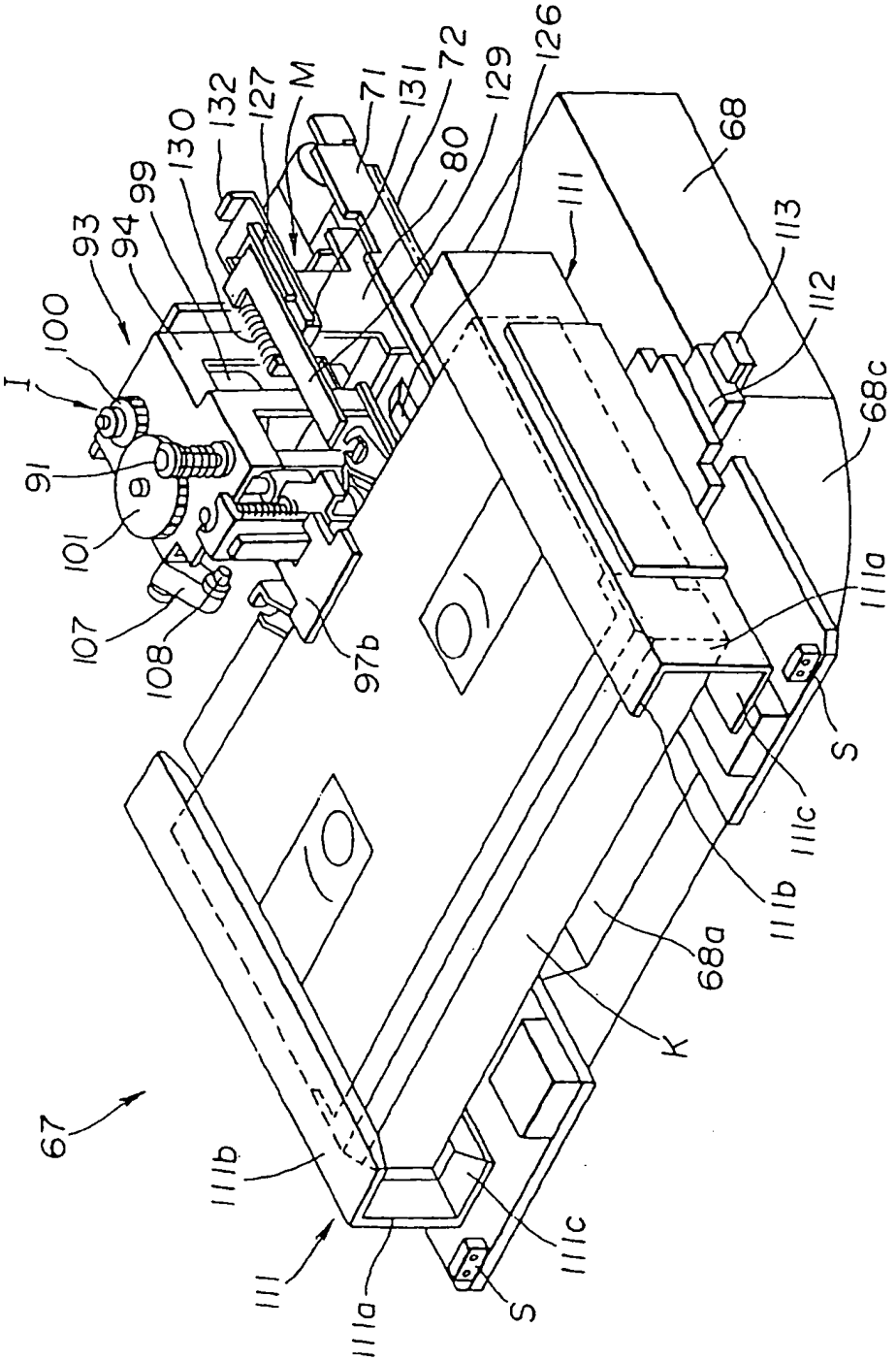

67
111b
111
111a
111c
S
K
68a
111b
111c
S
111a
68c
68
112
113
111
126
129
72
80
71
131
M
127
132
130
99
94
93
100
I
91
101
107
108
97b

FIG.31

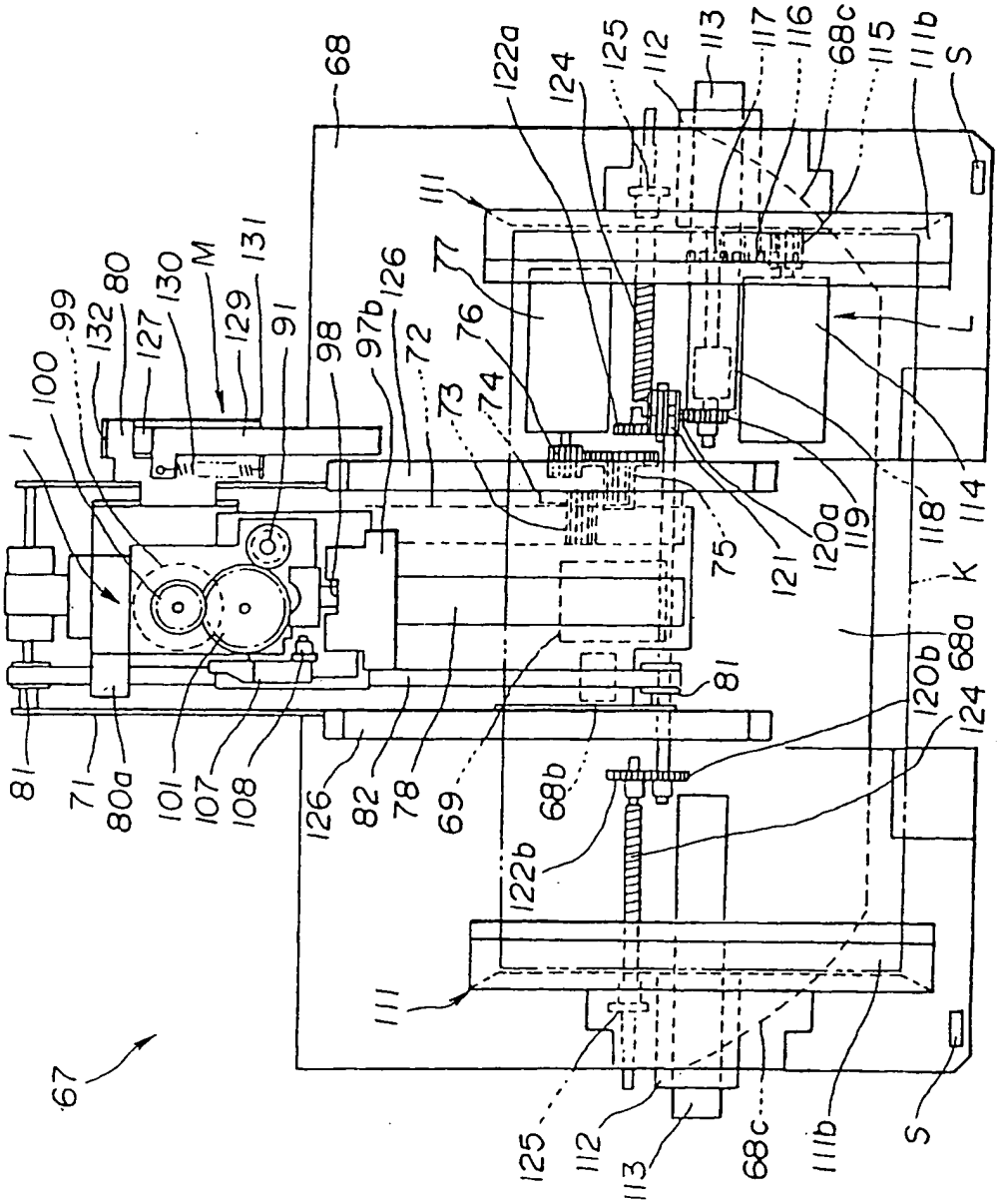

68
122a
124
125
112
113
117
116
68c
115
111b
S
111
L
77
76
74
73
72
126
97b
98
91
131
M
130
127
132
80
99
100
1
75
121
120a
119
118
114
K
68a
120b
124
81
68b
122b
69
78
82
126
108
107
101
80a
71
81
67

FIG.32

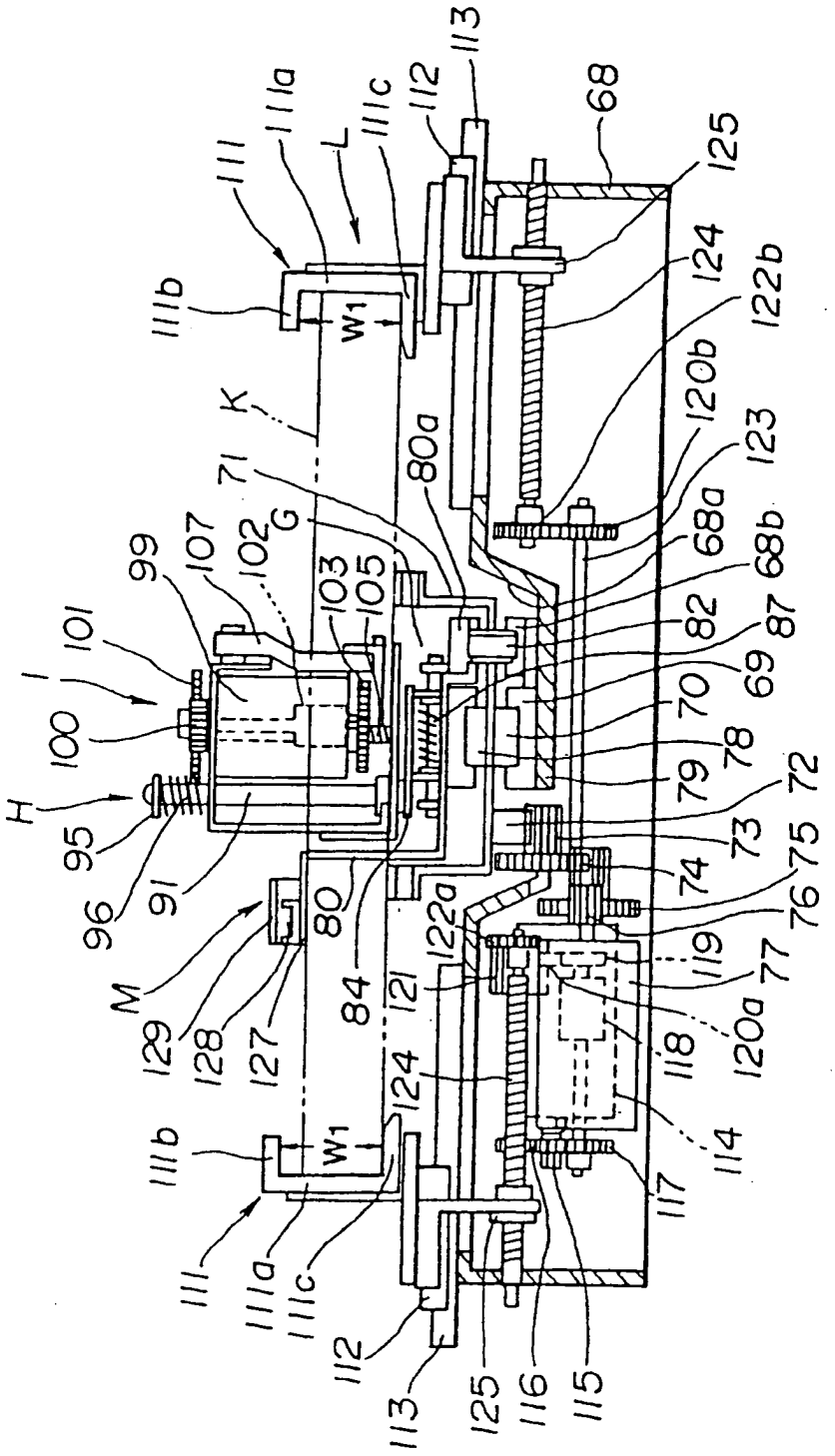

113
112
111a
111c
111
L
68
125
124
122b
111b
W1
K
120b
123
71
80a
68a
68b
G
107
102
99
103
105
82
87
101
69
70
1
100
78
79
72
H
73
74
75
95
96
91
80
76
M
122a
119
77
84
121
129
128
127
118
120a
124
114
117
111b
W1
111
111a
111c
112
113
125
116
115

FIG.33

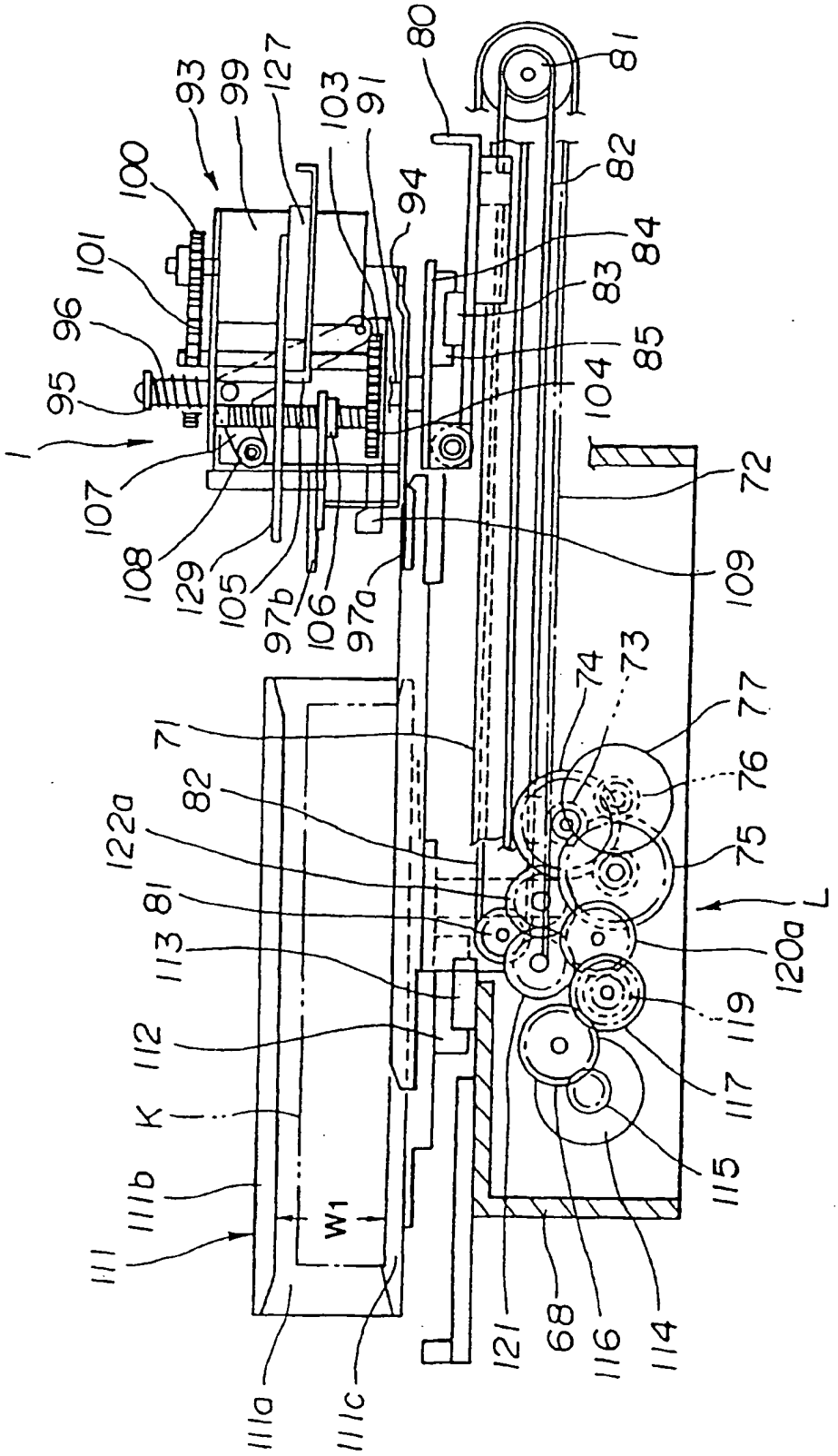

80
81
82
84
83
85
104
72
109
93
99
127
103
91
94
100
101
96
95
1
107
108
129
105
97b
106
97a
74
73
77
76
75
71
82
122a
81
113
112
K
111b
111
W1
111a
111c
120a
L
119
117
115
121
68
116
114

FIG.34

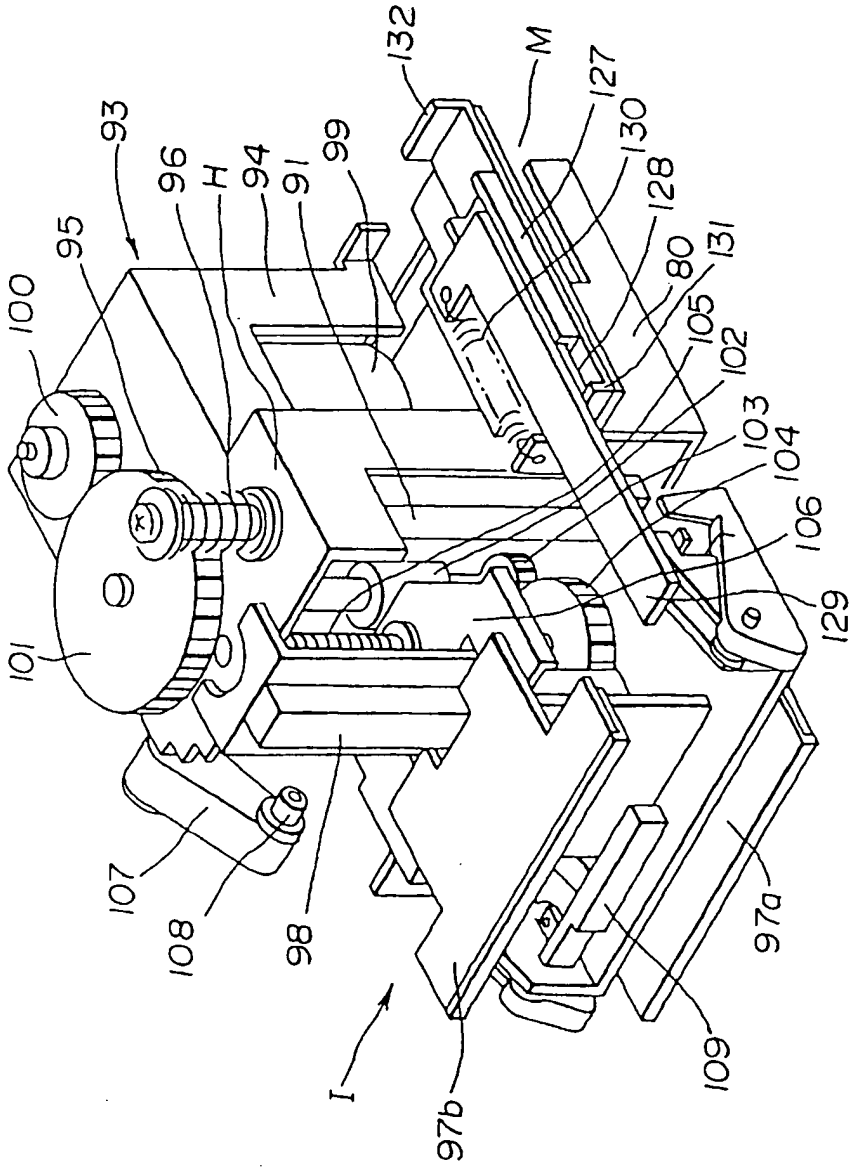

132
M
127
130
128
131
80
105
102
103
104
106
129
93
96
H
94
91
99
95
100
101
107
108
98
I
97b
97a
109

FIG.35

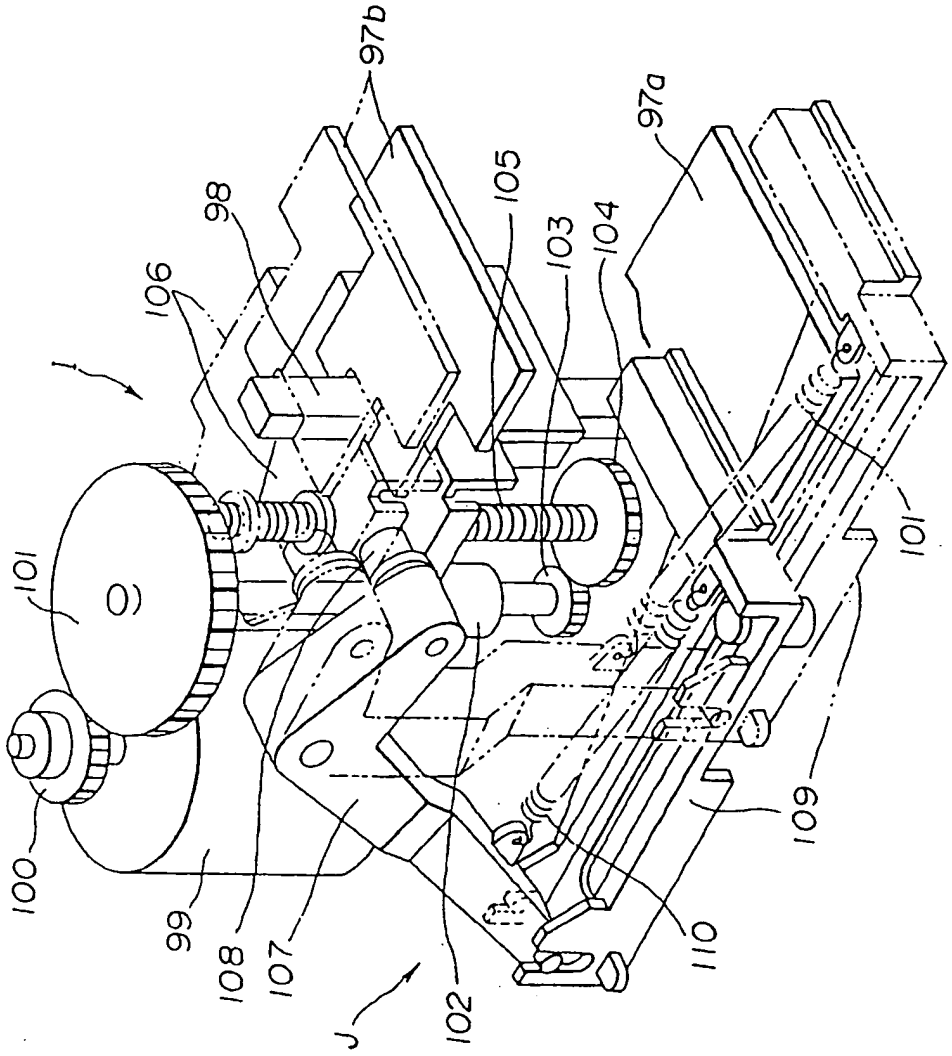


FIG.36B

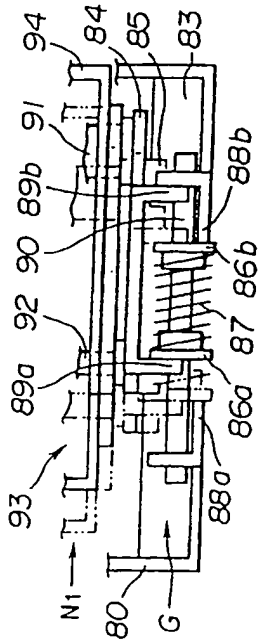


FIG.36C

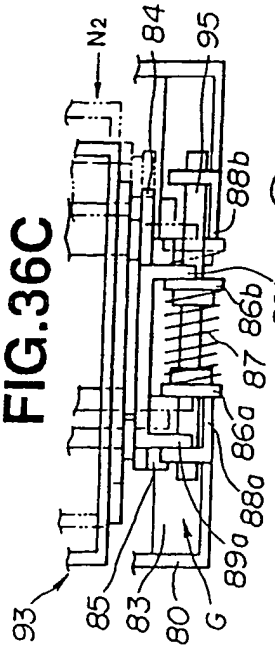


FIG.36D

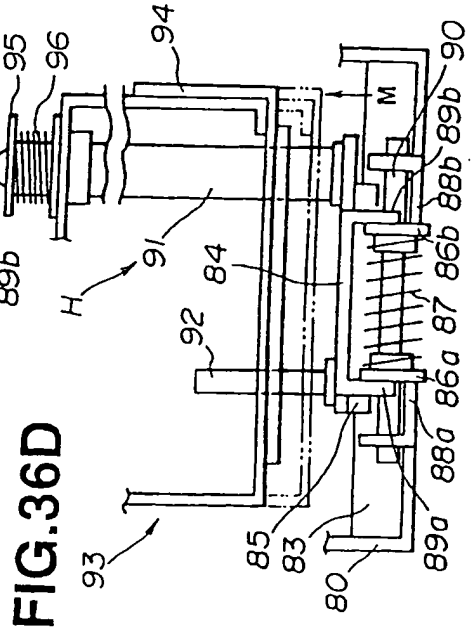


FIG.36A

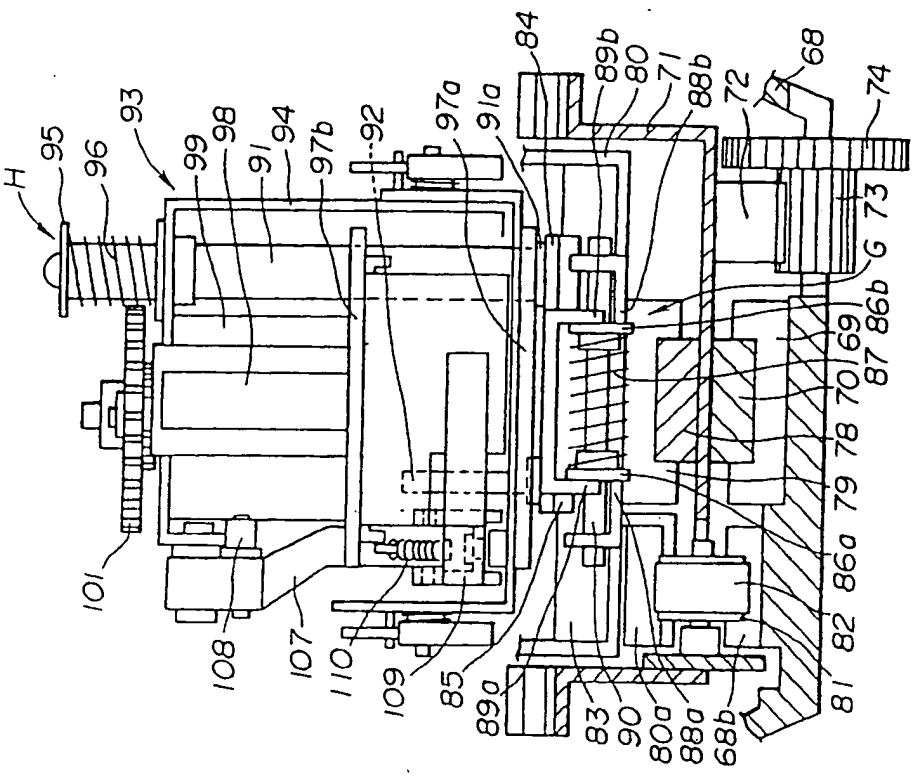


FIG.37A

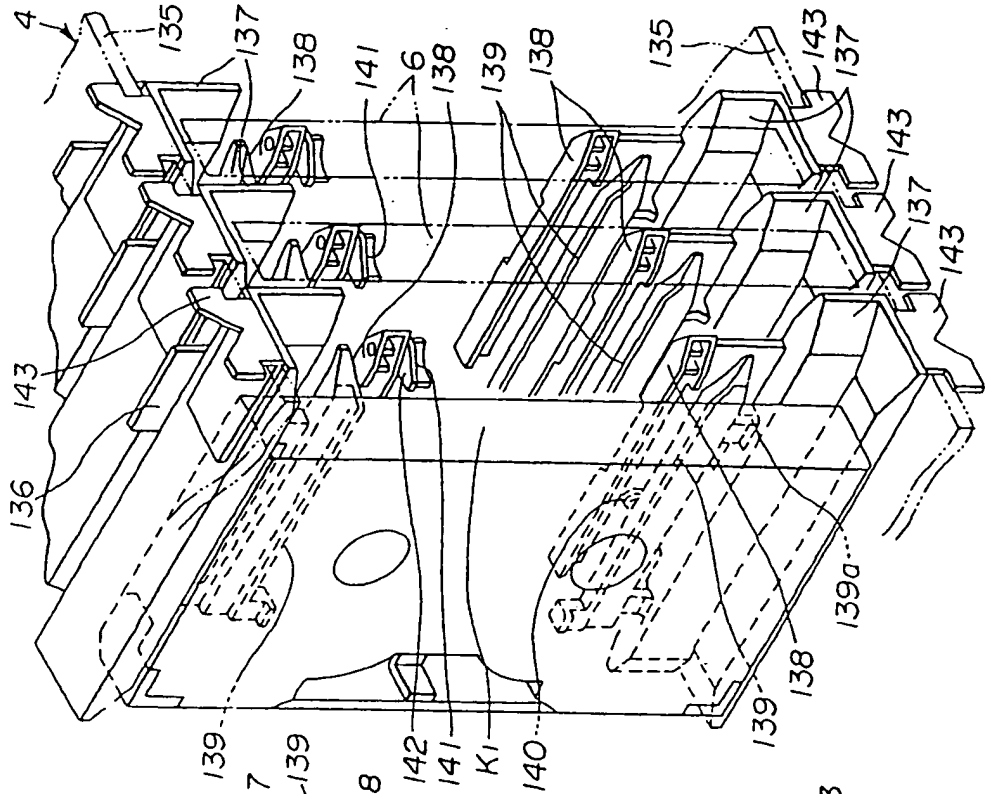


FIG.37B

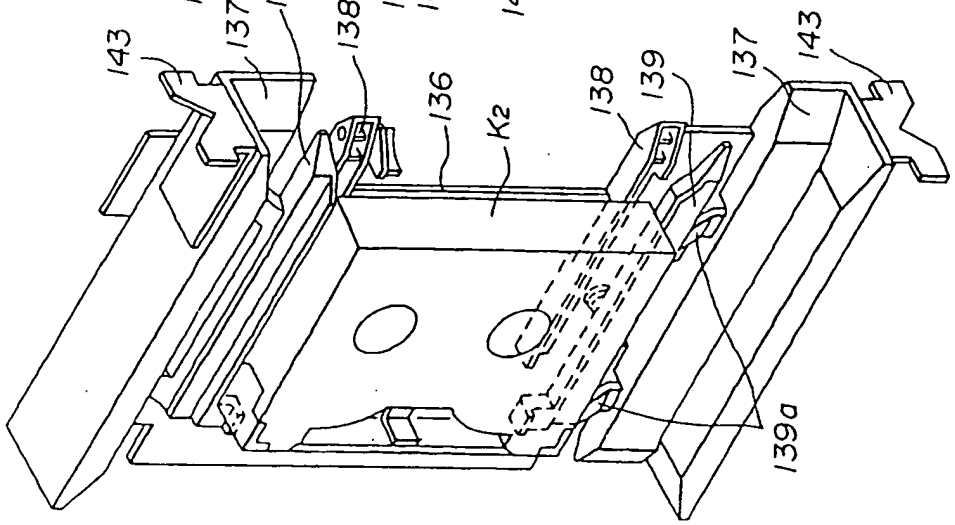


FIG.38

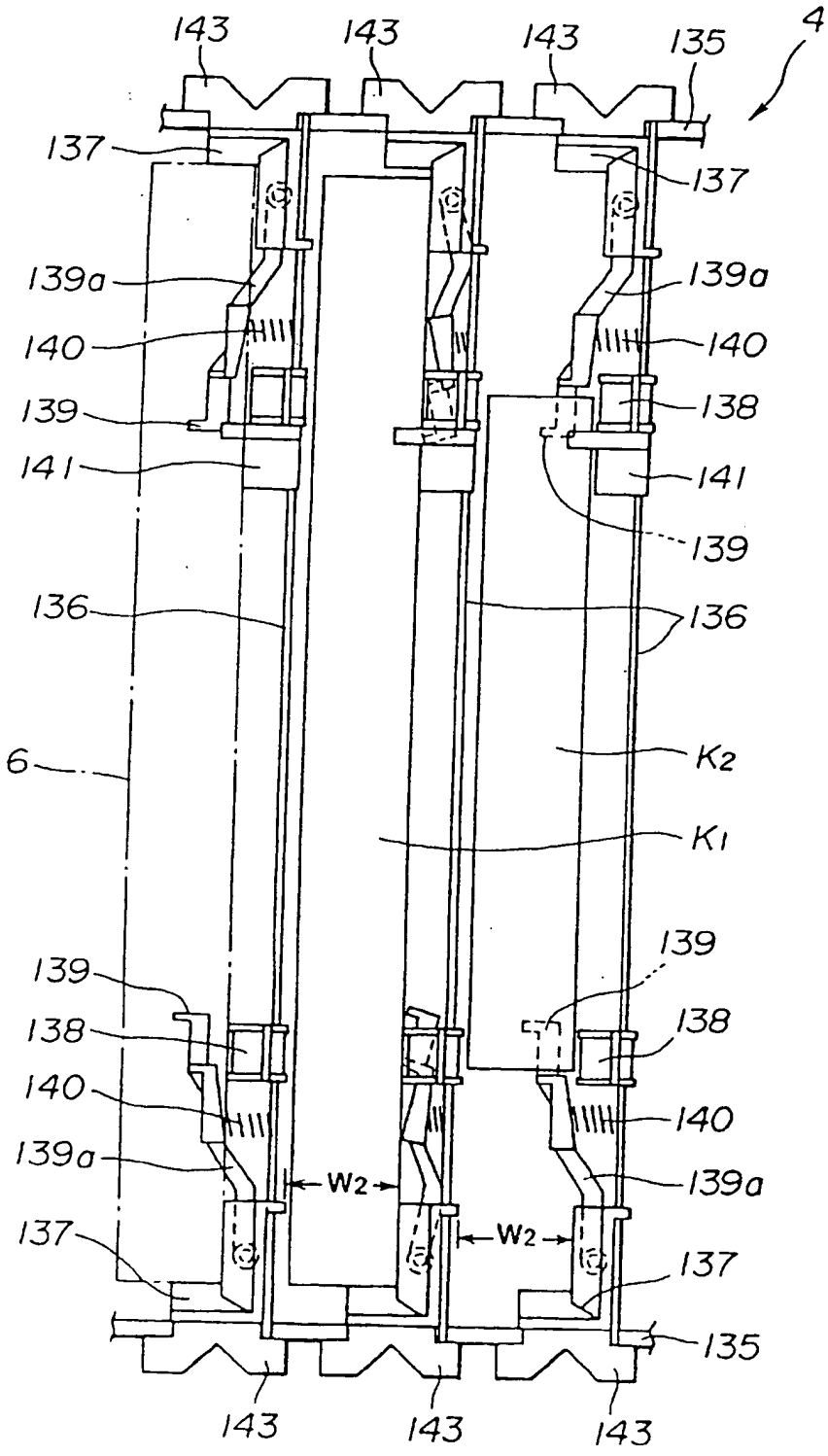
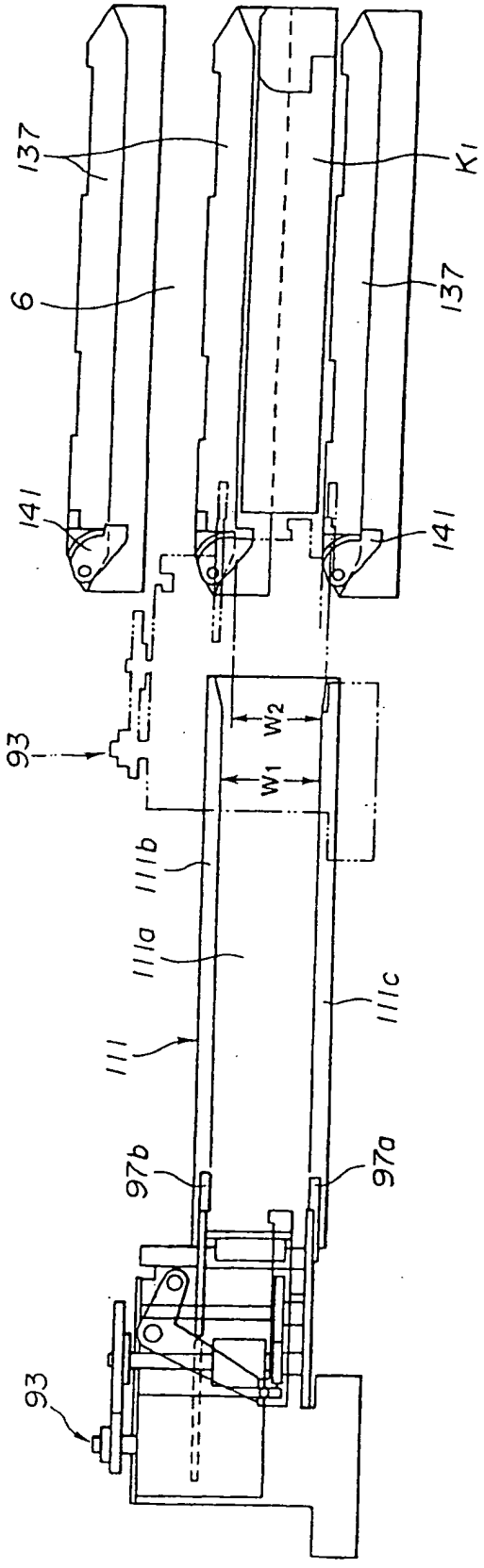

143
143
143
135
4
137
137
139a
139a
140
140
139
138
141
141
139
136
136
6
K2
K1
139
139
138
138
140
140
139a
139a
W2
W2
137
137
135
143
143
143

FIG.39



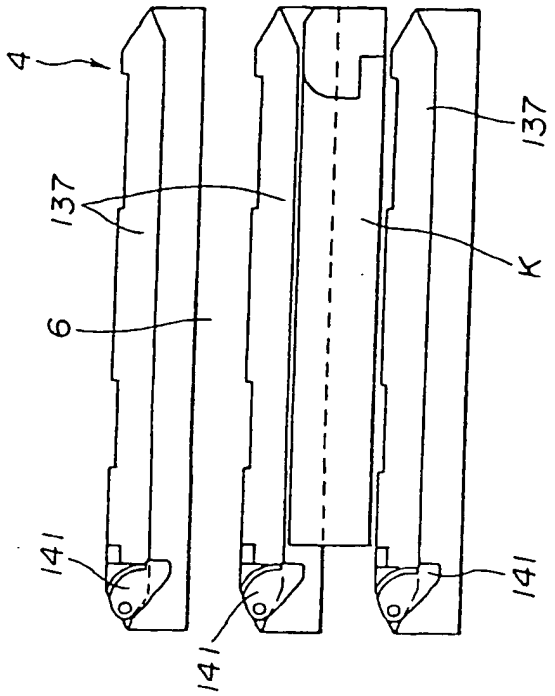


FIG.40

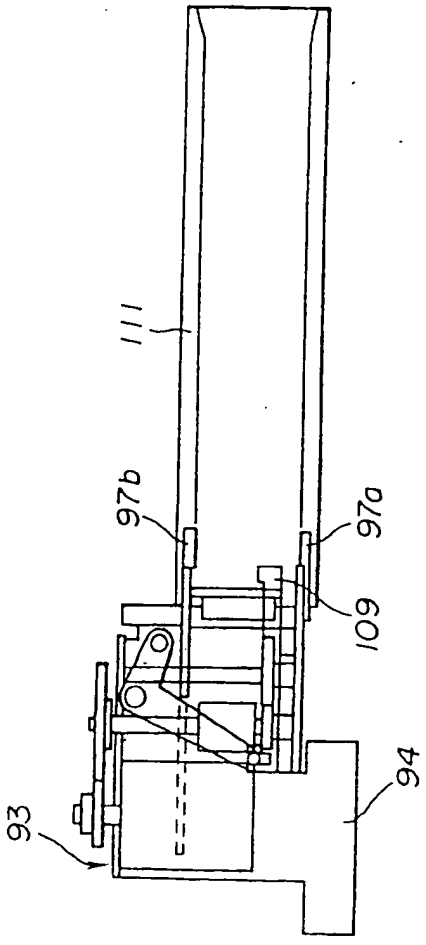


FIG.41

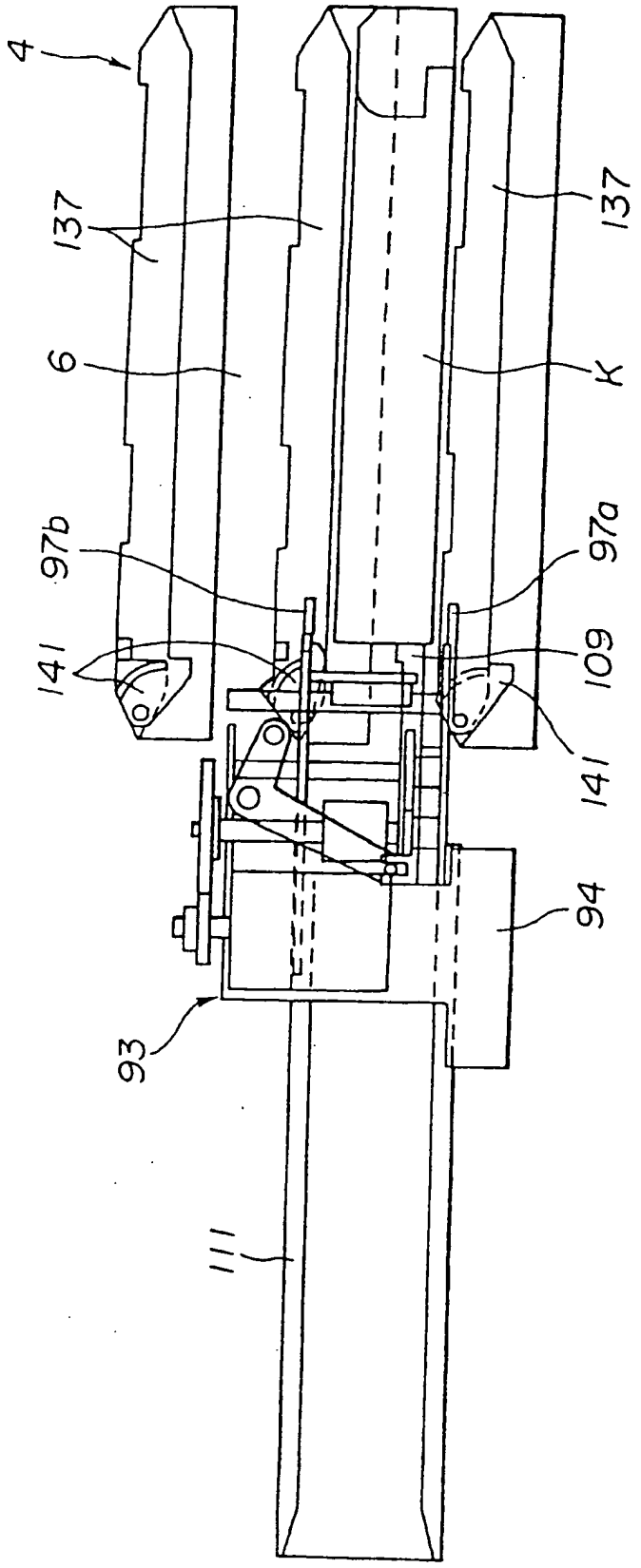
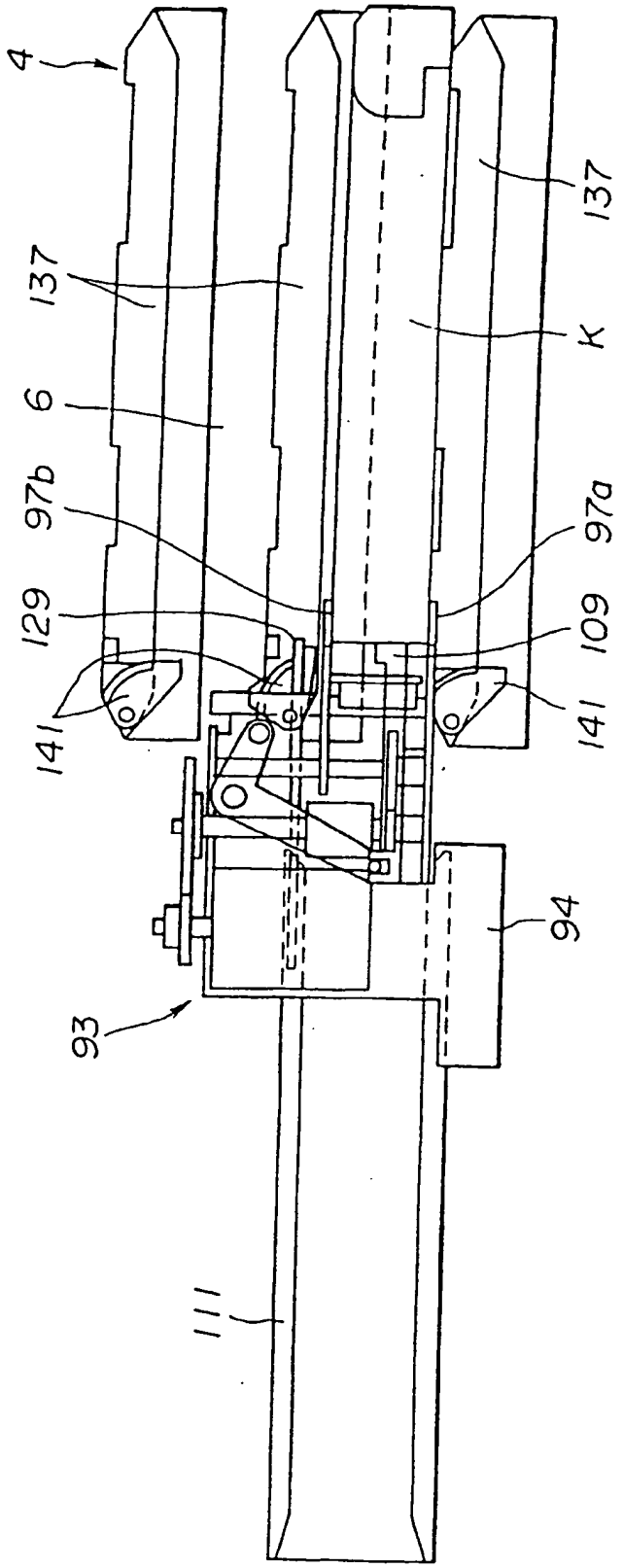


FIG.42



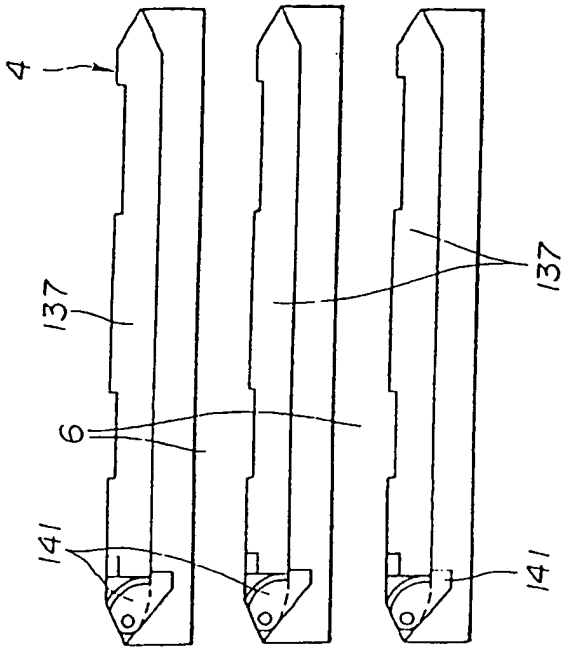


FIG.43

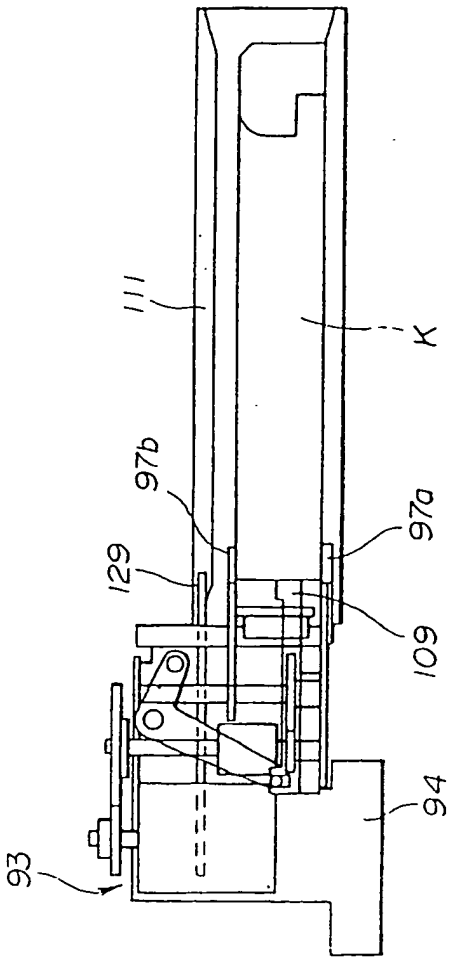


FIG.44

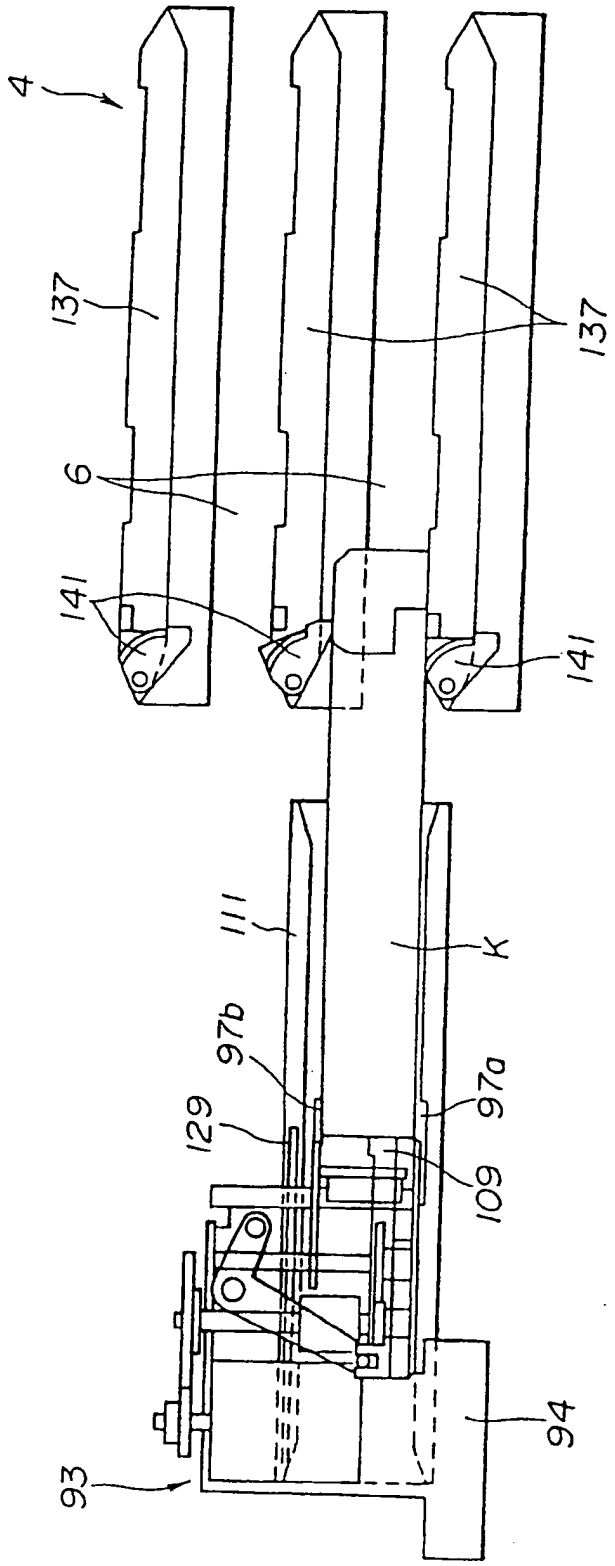


FIG.45

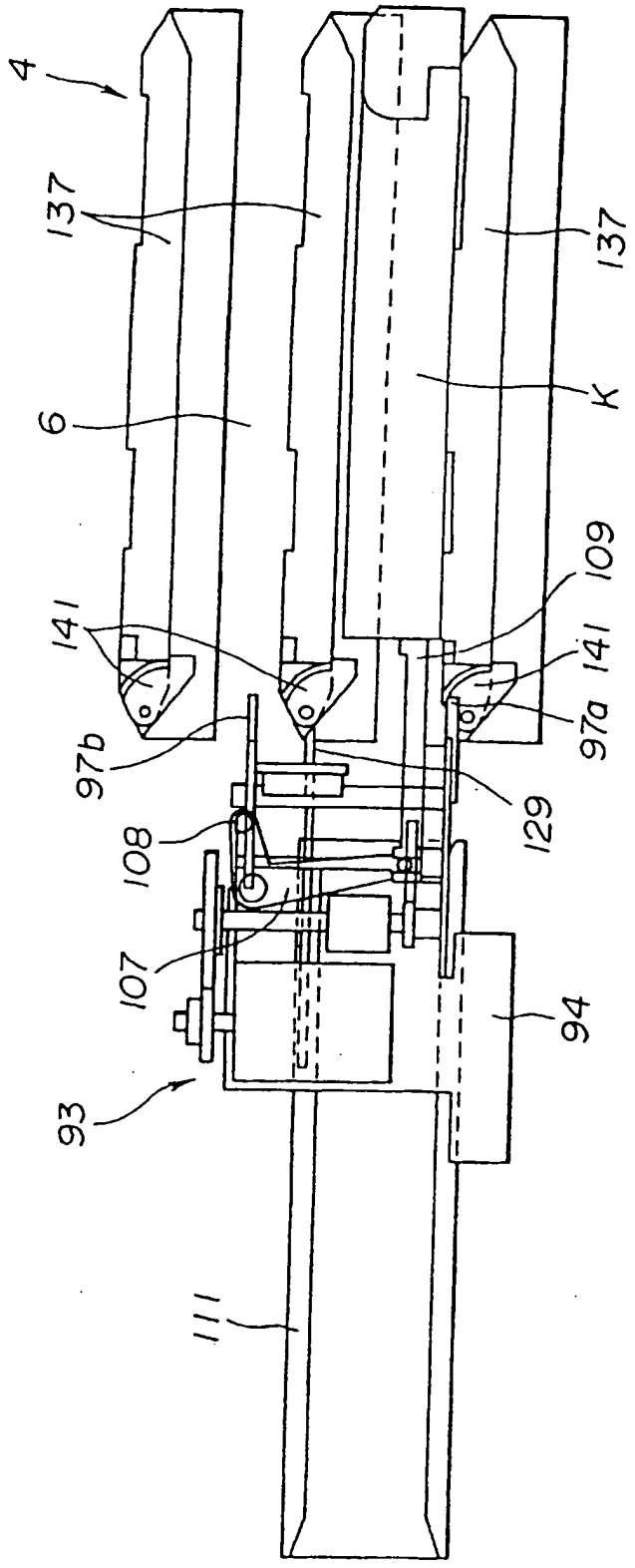


FIG.46

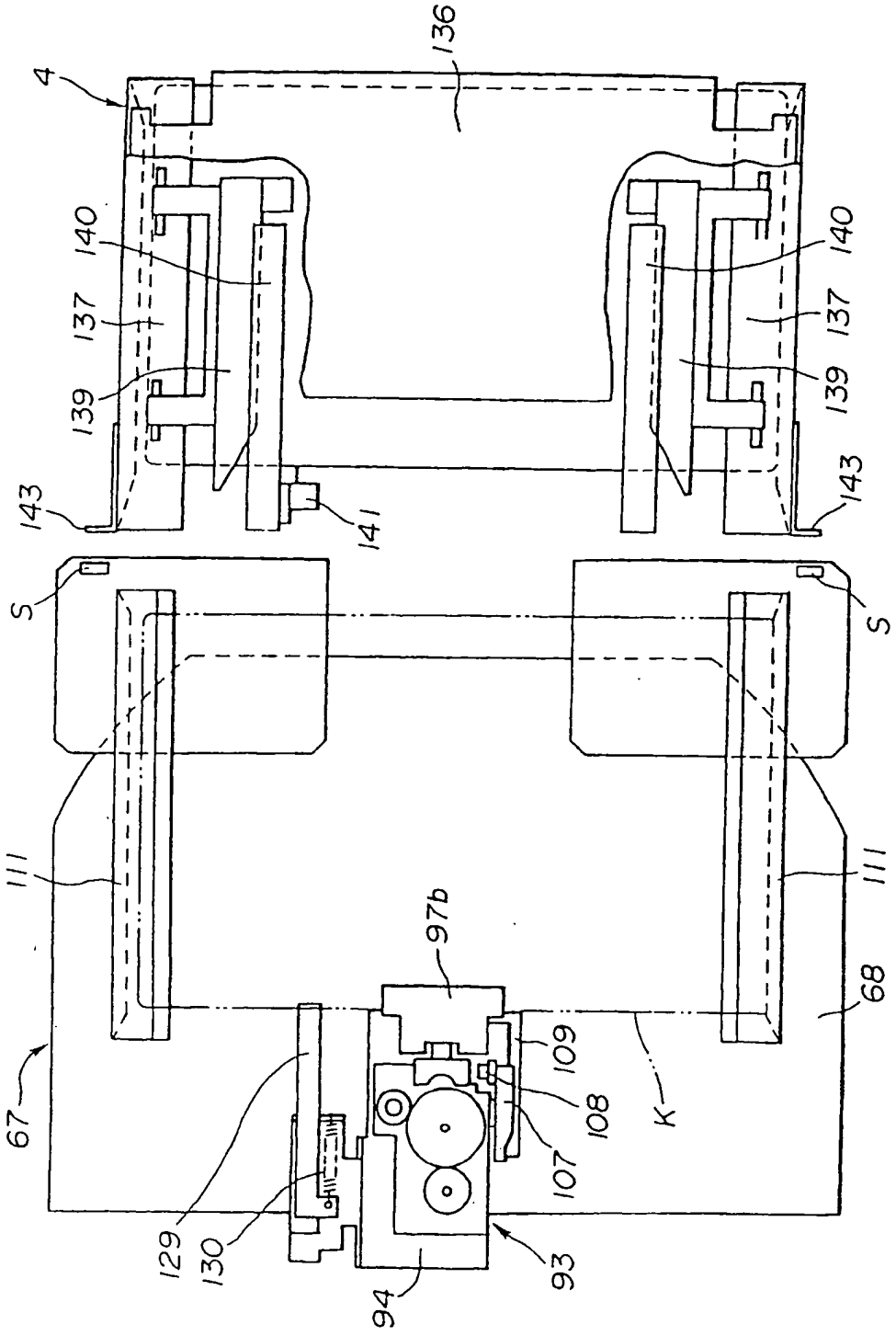

136
4
140
137
139
143
141
140
137
139
143
S
S
111
111
97b
68
67
109
108
107
K
129
130
94
93

FIG.47

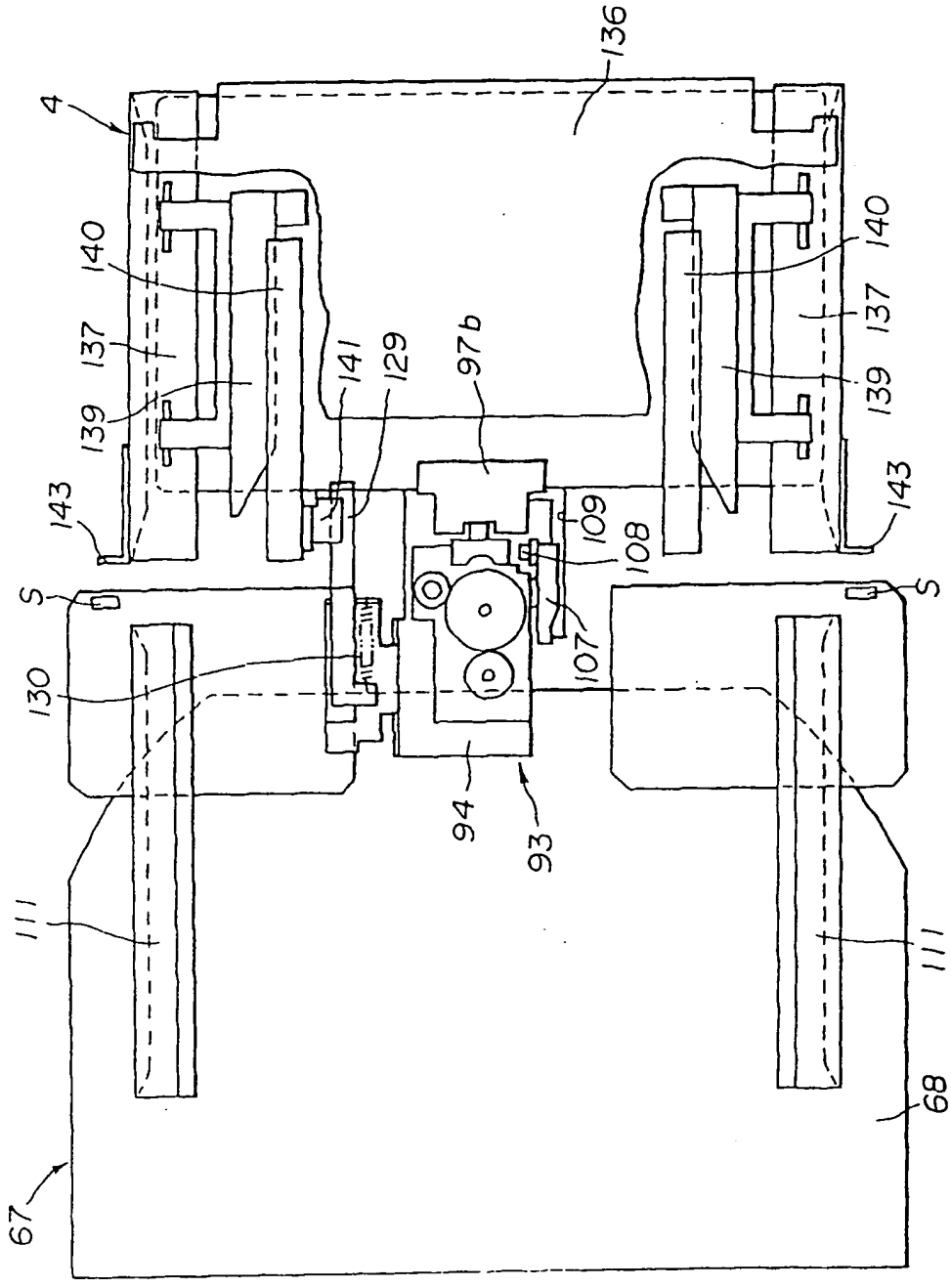


FIG.48

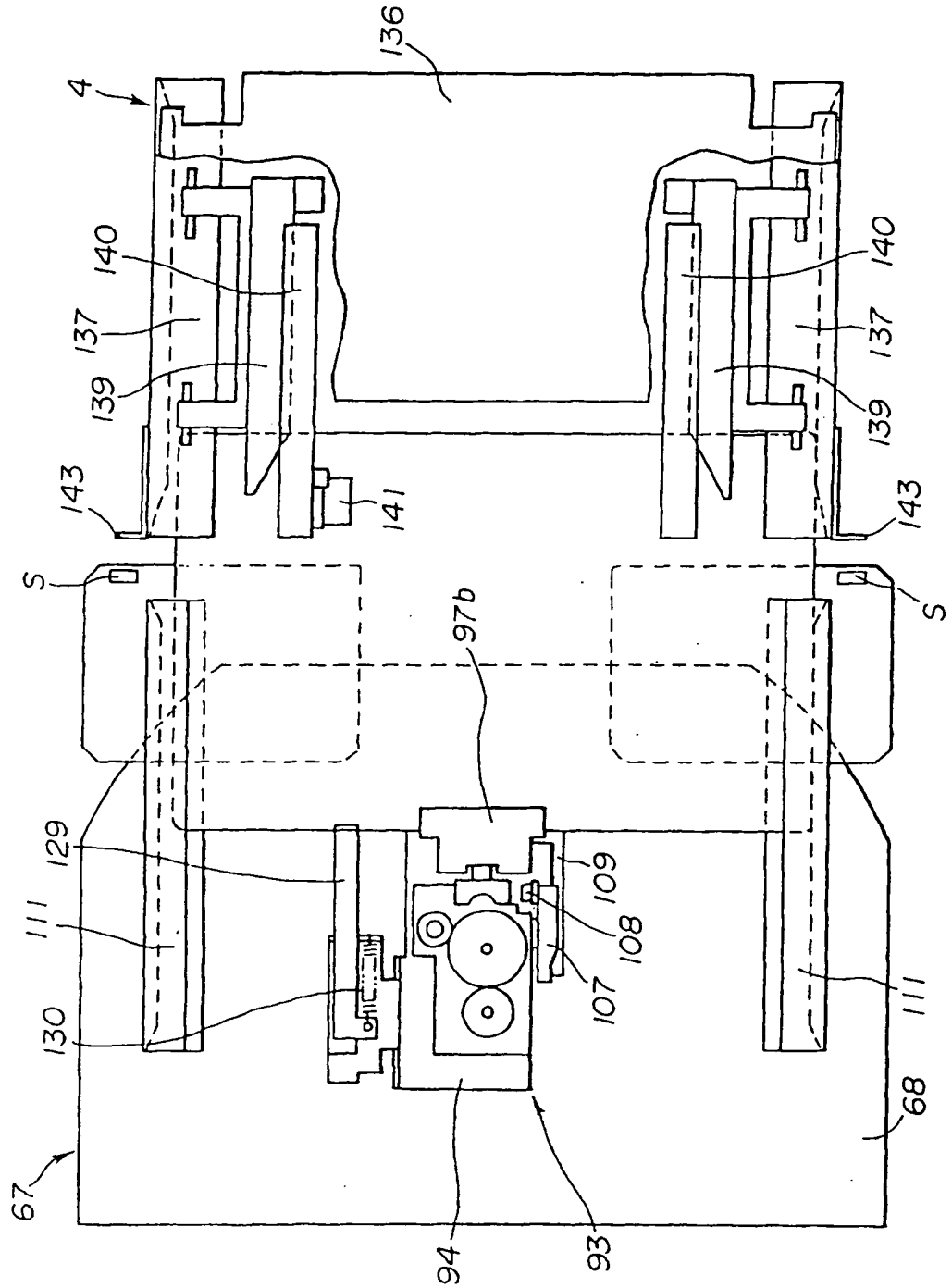


FIG.49

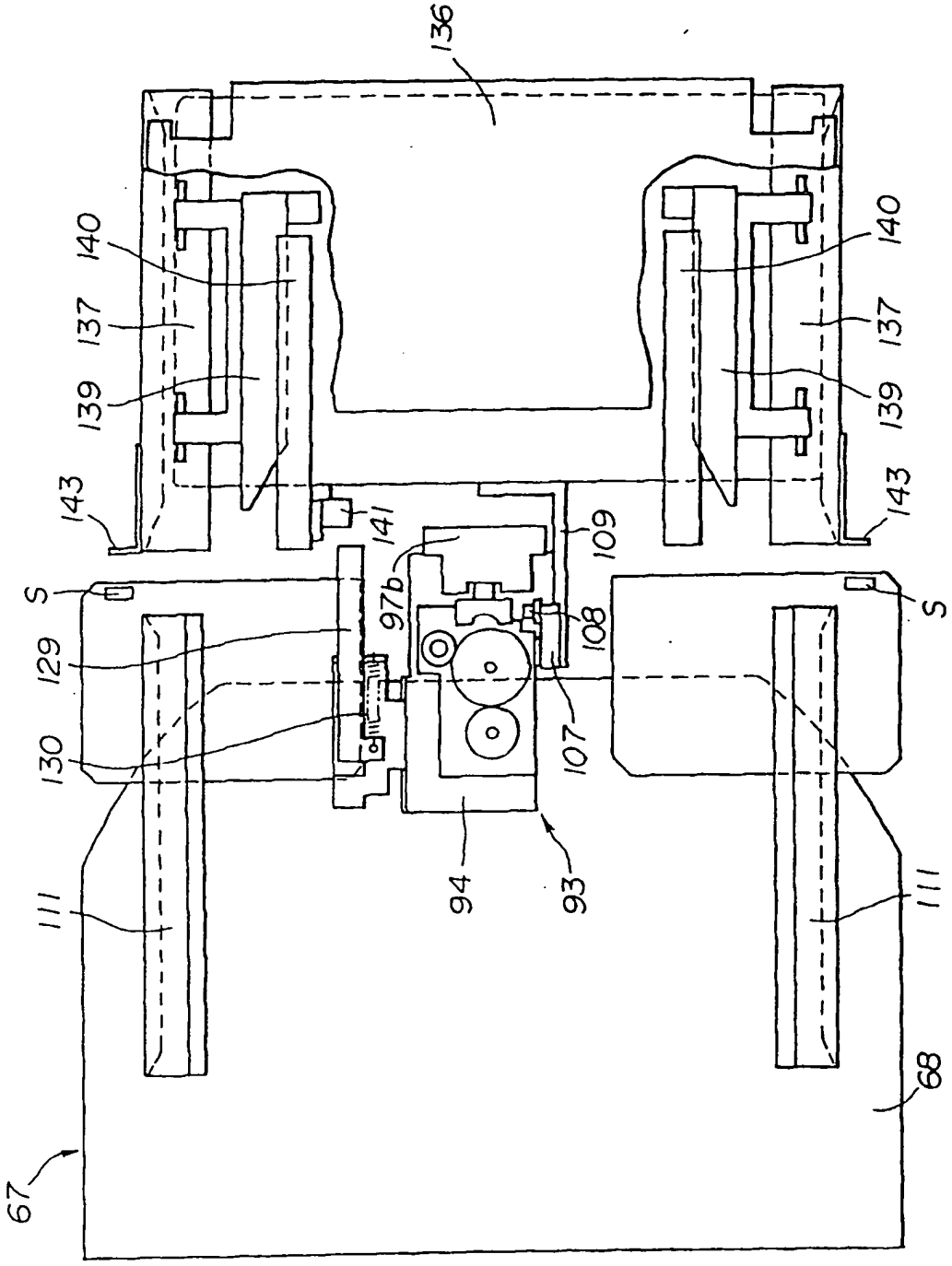


FIG.50

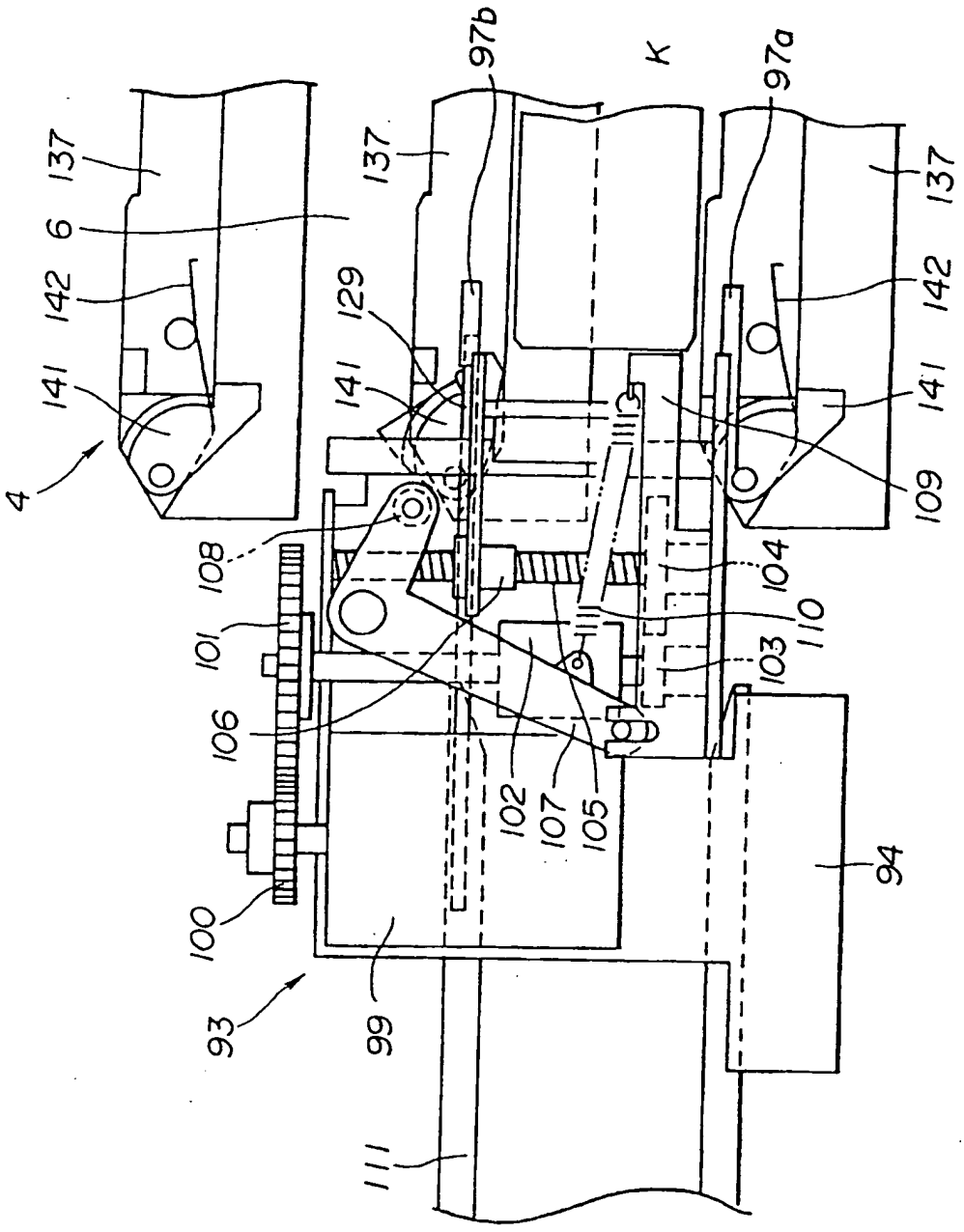

97b
K
97a
137
6
142
129
141
4
108
101
106
100
93
99
111
102
107
105
104
110
103
109
94

FIG.51

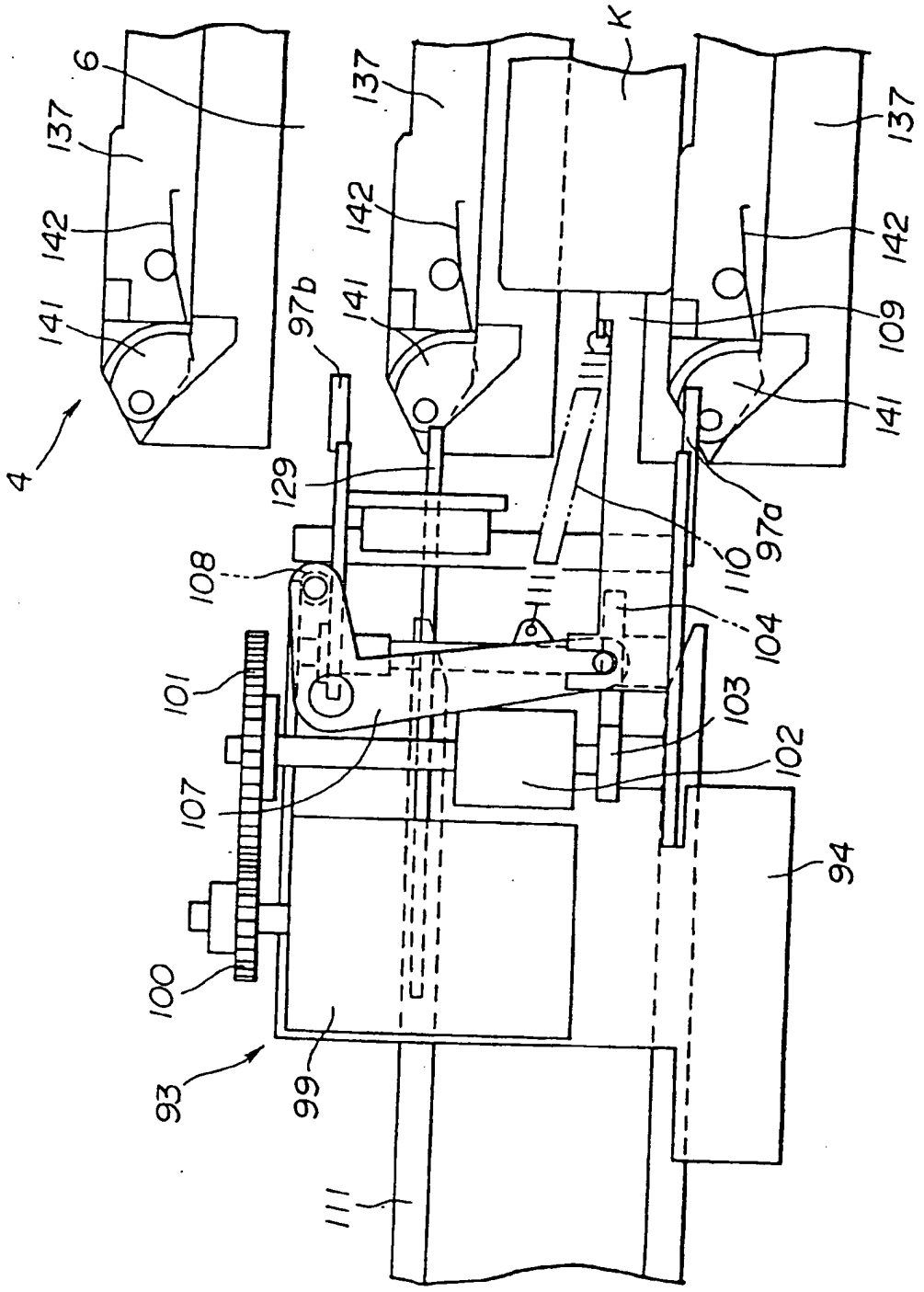

6
137
142
141
4
97b
129
108
101
107
100
93
99
111
K
137
142
141
137
142
109
141
97a
110
104
103
102
94

FIG.52A

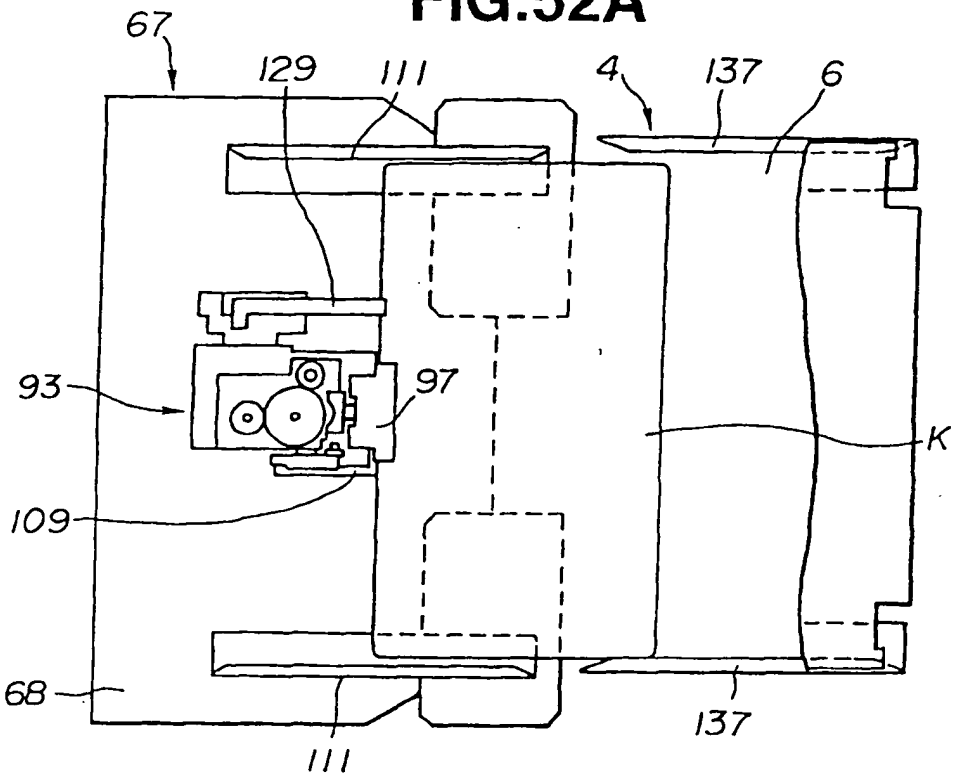


FIG.52B

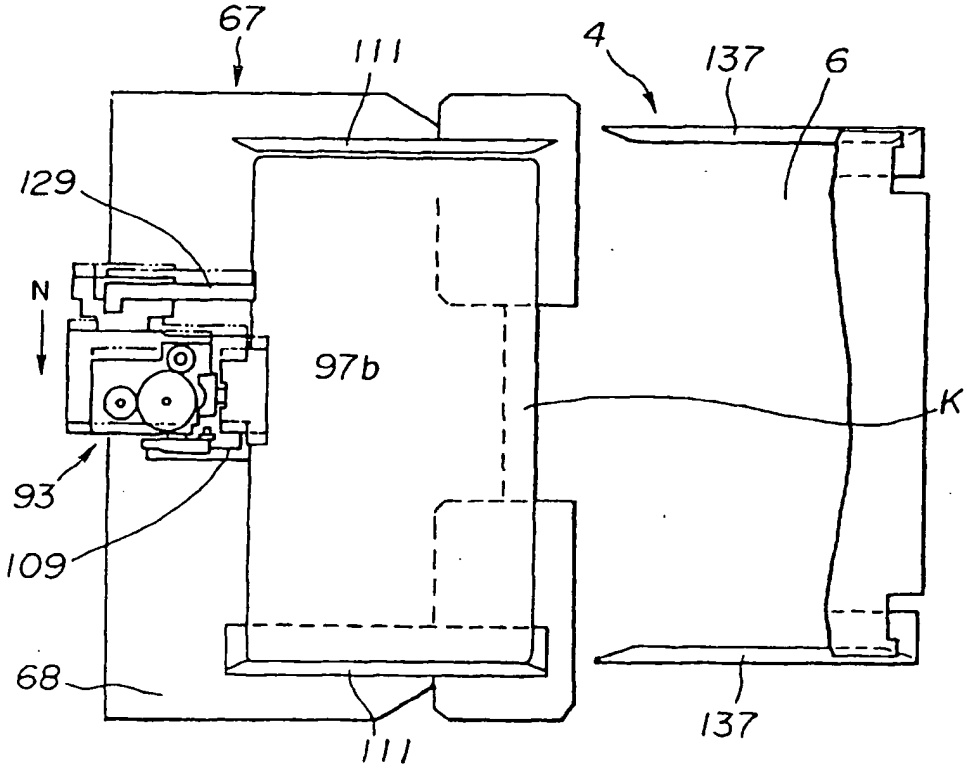


FIG.53

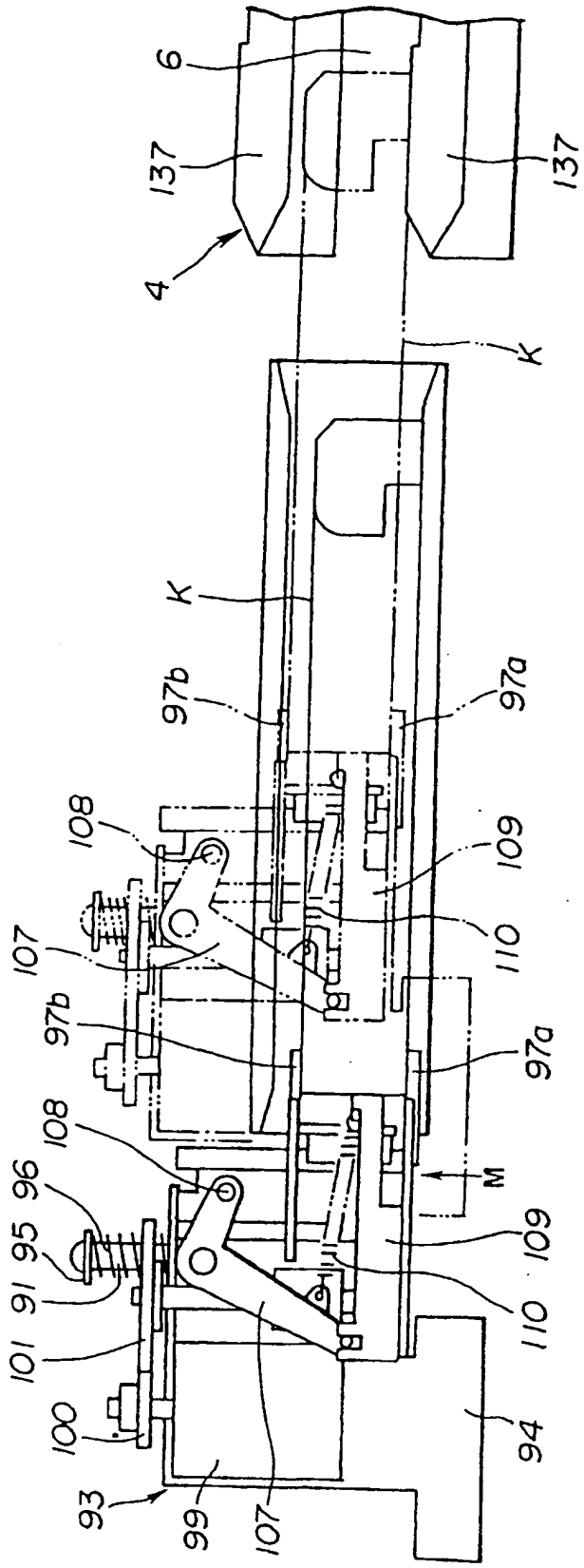

6
137
137
4
K
K
97b
97a
108
109
107
110
97b
97a
108
96
95
91
101
100
93
99
107
M
109
110
94

FIG.54A

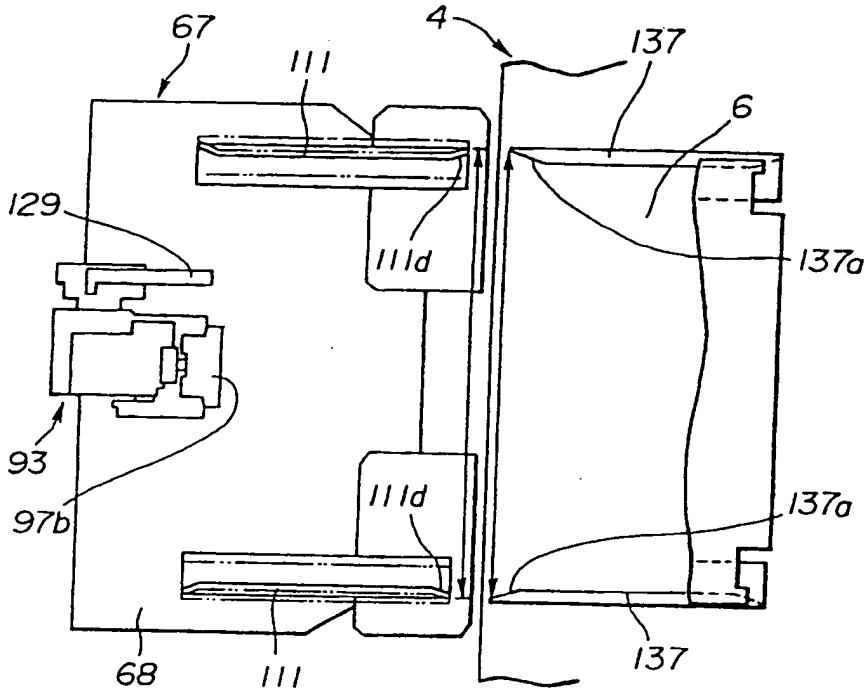


FIG.54B

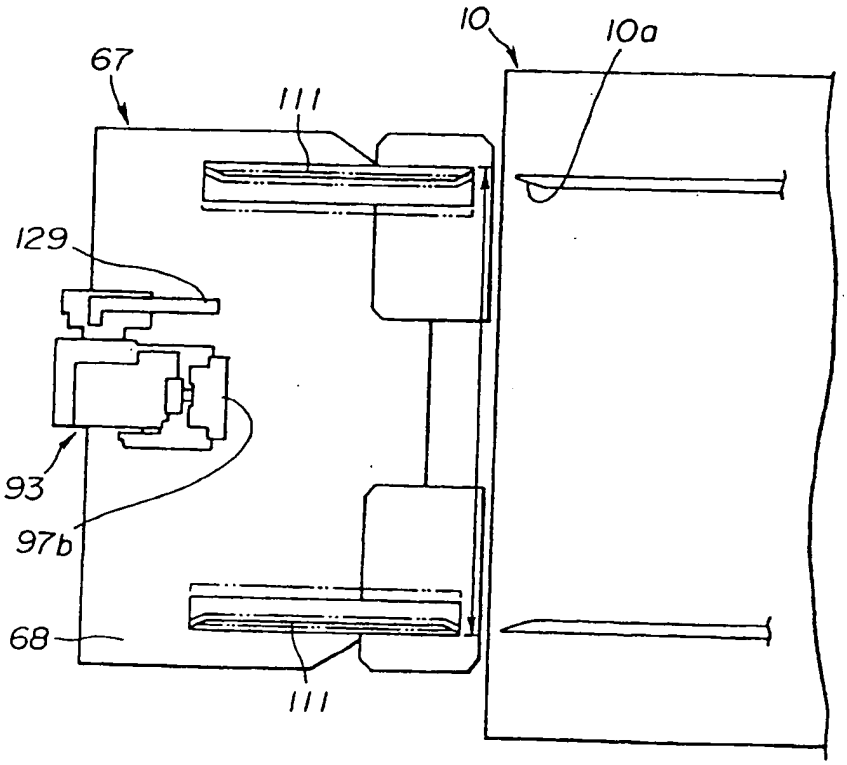


FIG.55

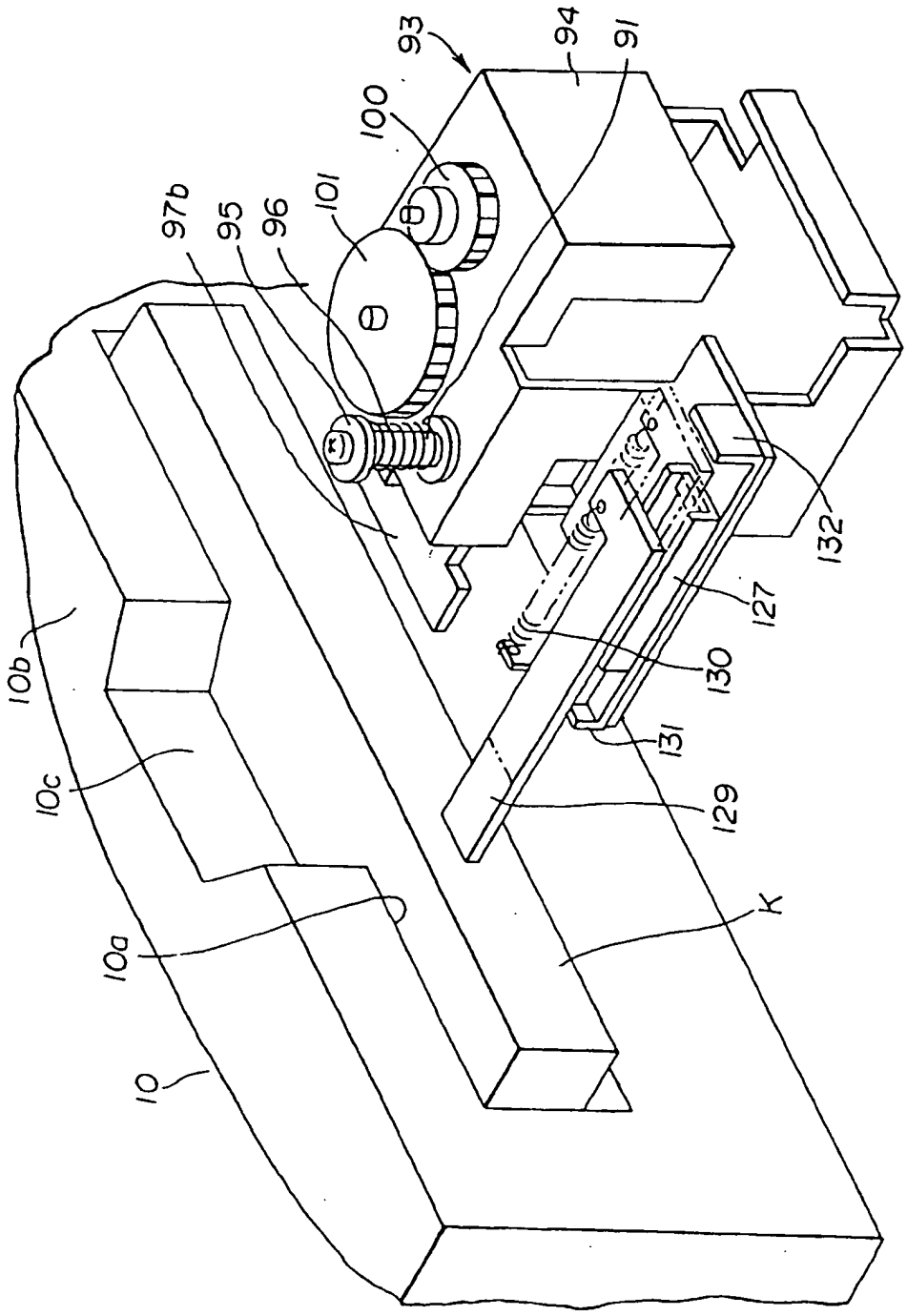


FIG.56

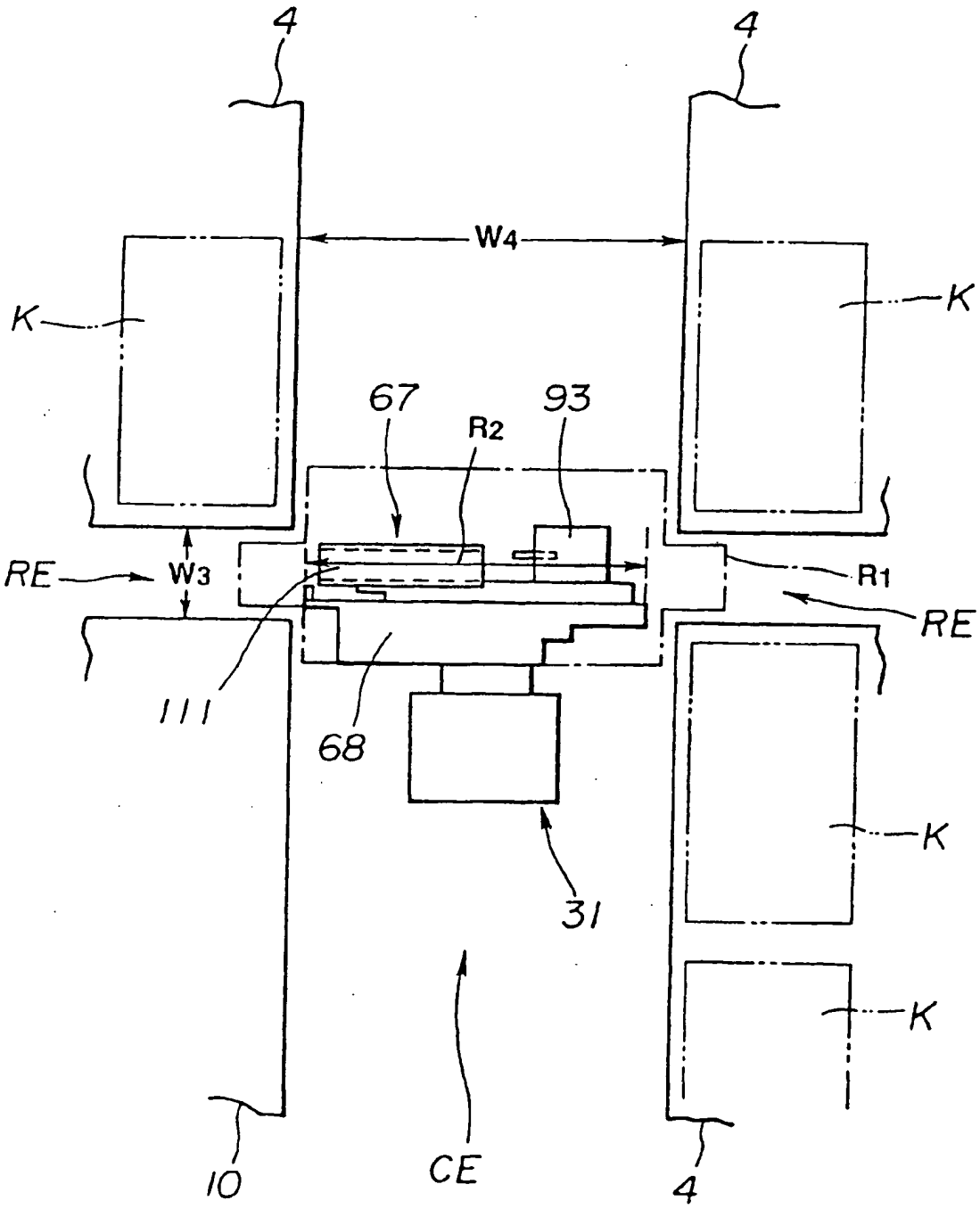


FIG.57

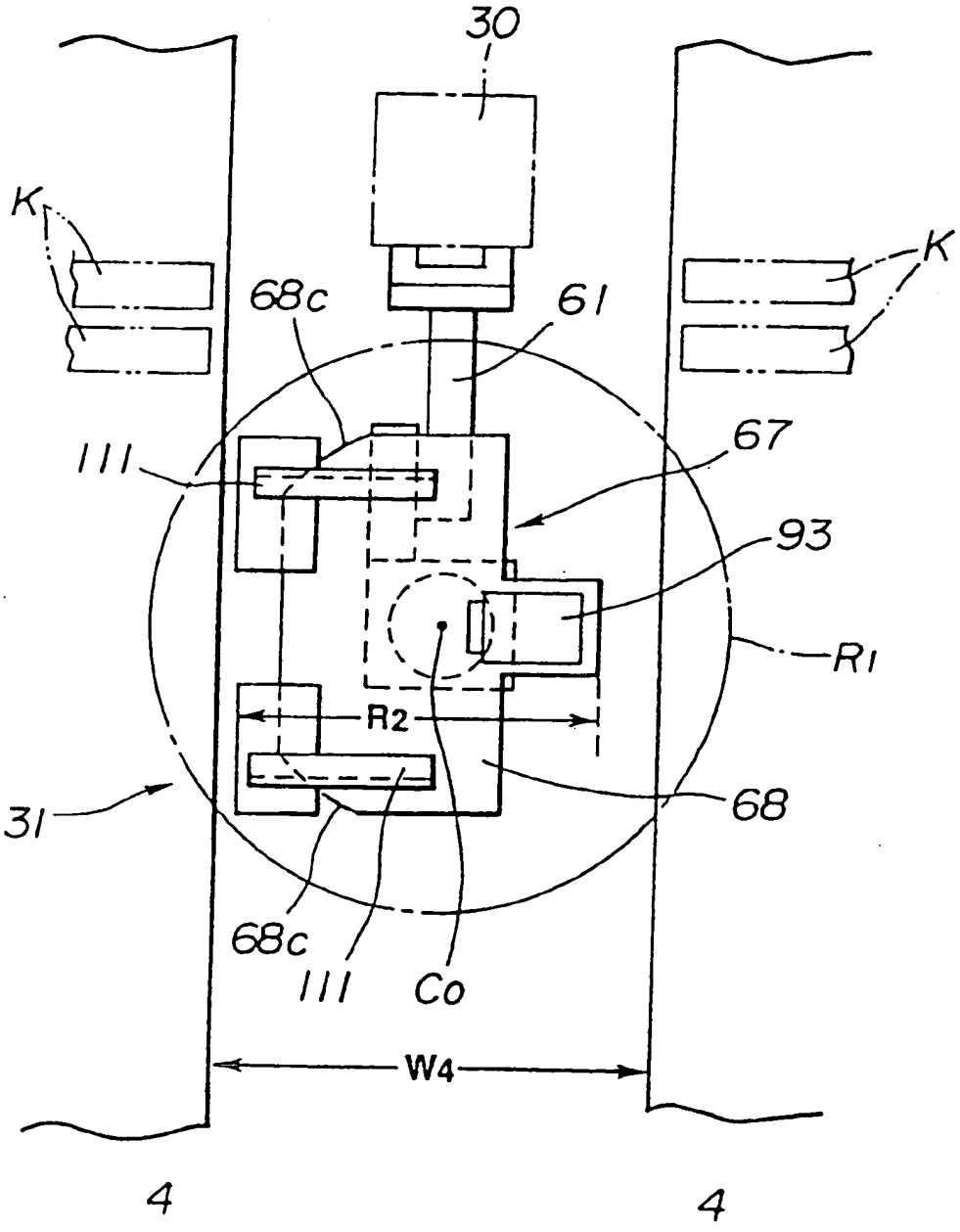


FIG.58

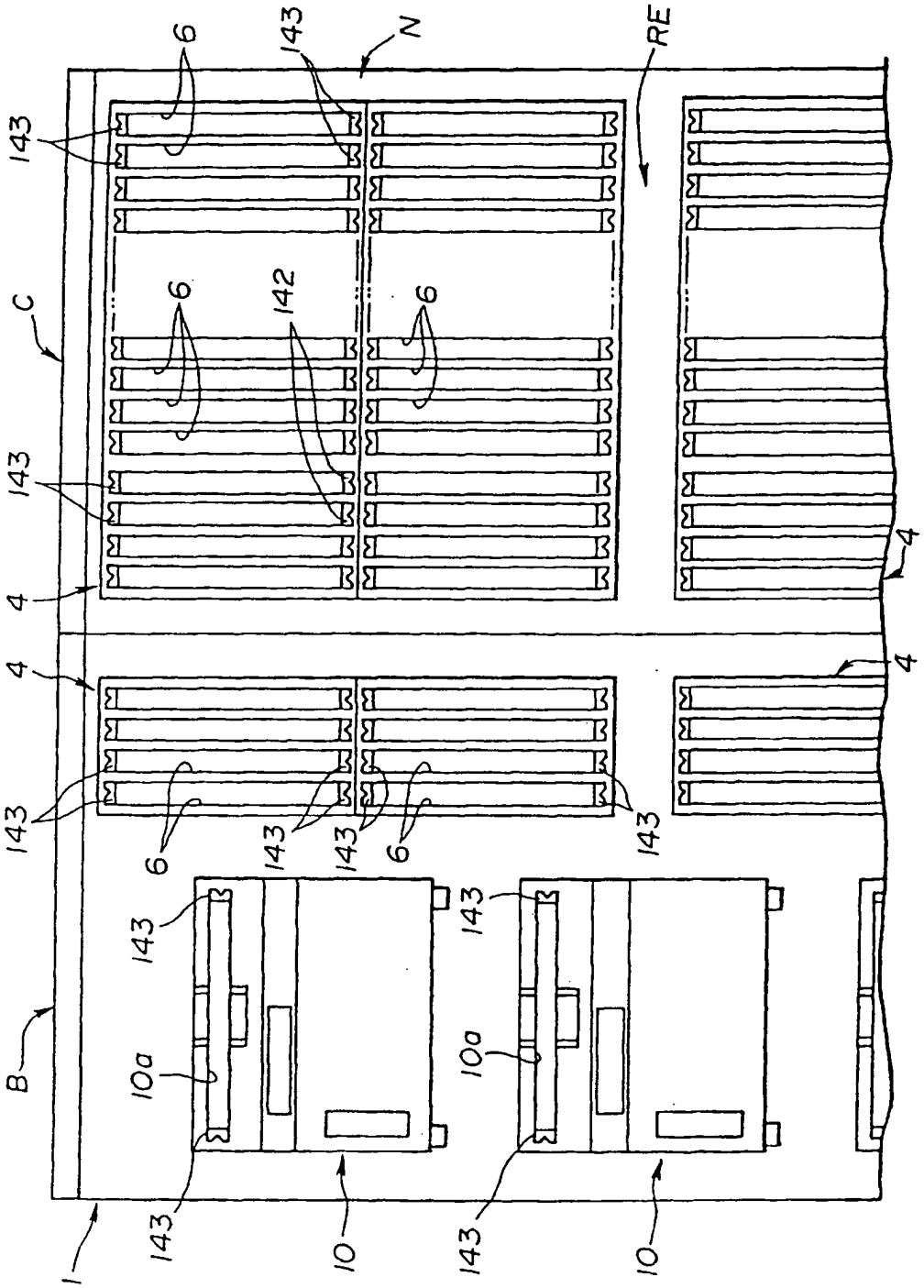

6
143
N
RE
143
C
6
142
6
143
4
4
4
143
6
143
143
6
143
143
B
10a
10a
143
143
1
10
10

FIG.59A

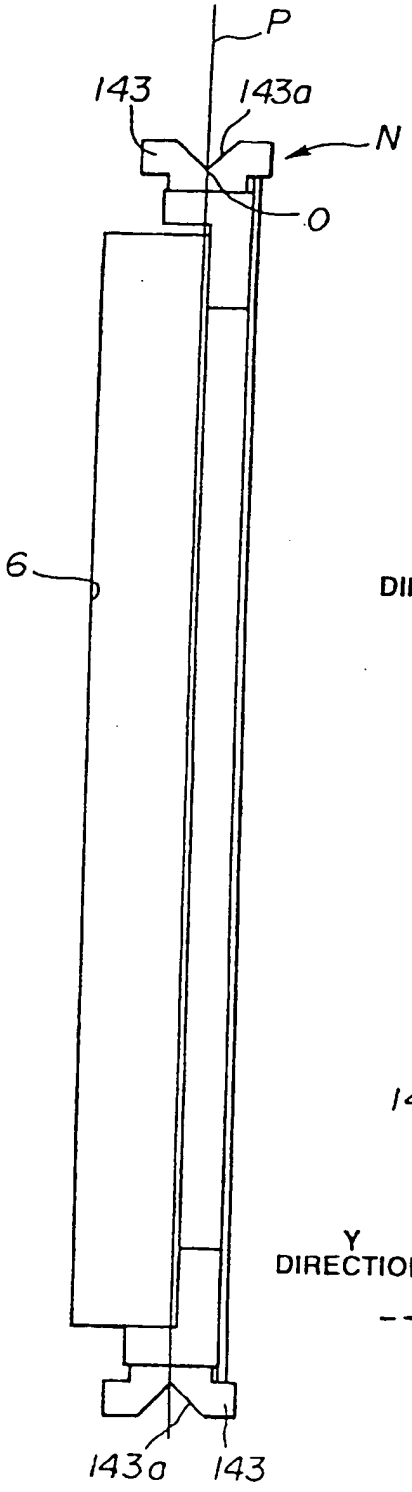


FIG.59B

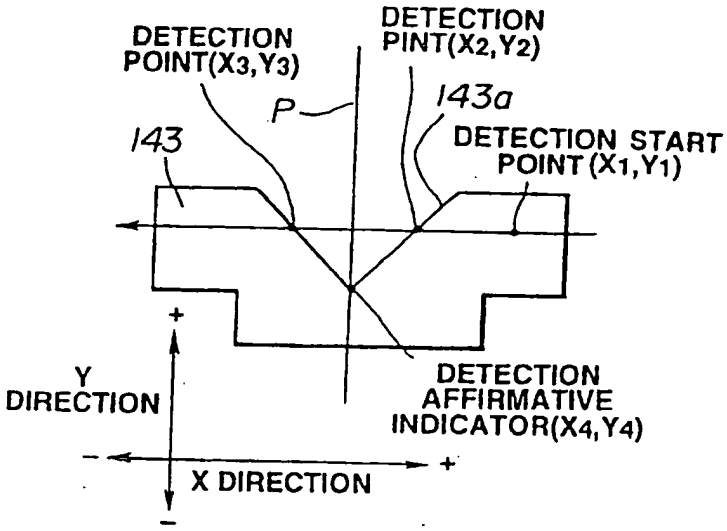


FIG.59C

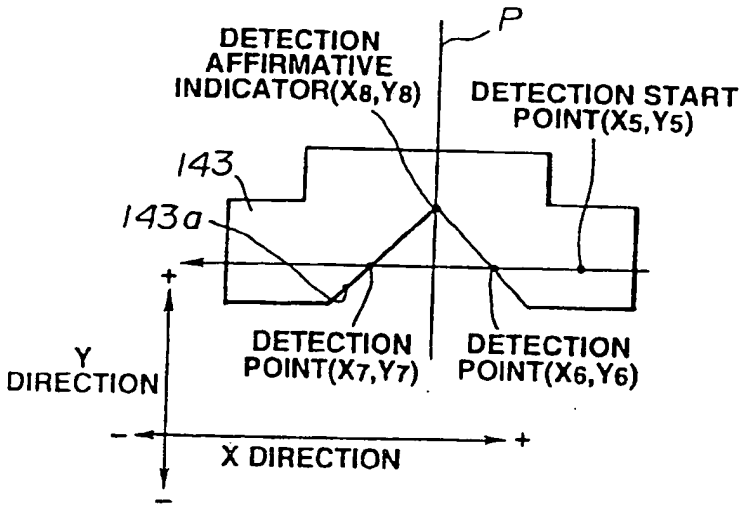


FIG.60

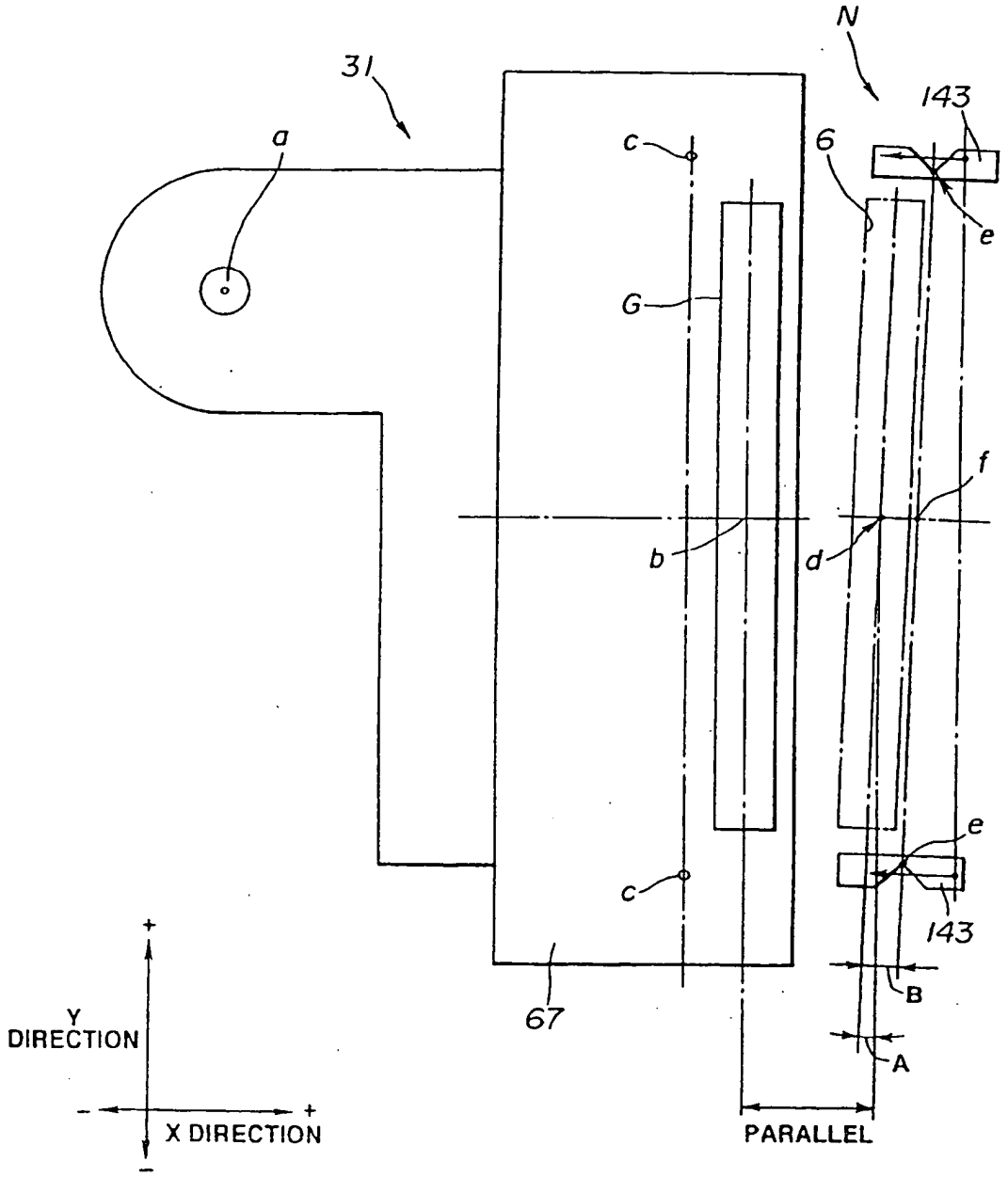

N
31
143
a
c
6
e
G
f
b
d
e
c
143
B
67
A
Y
DIRECTION
X DIRECTION
PARALLEL

FIG.61

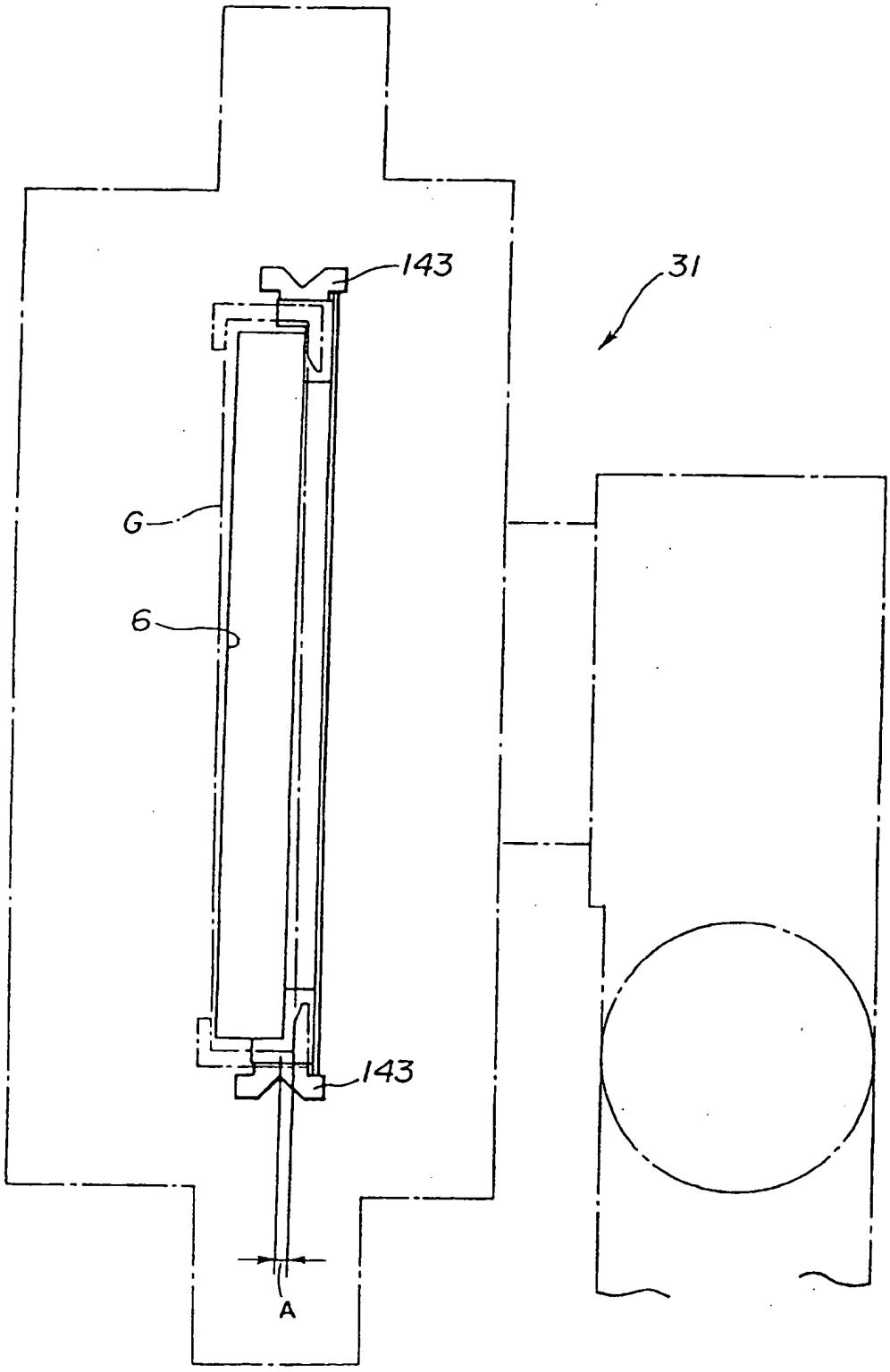


FIG.62

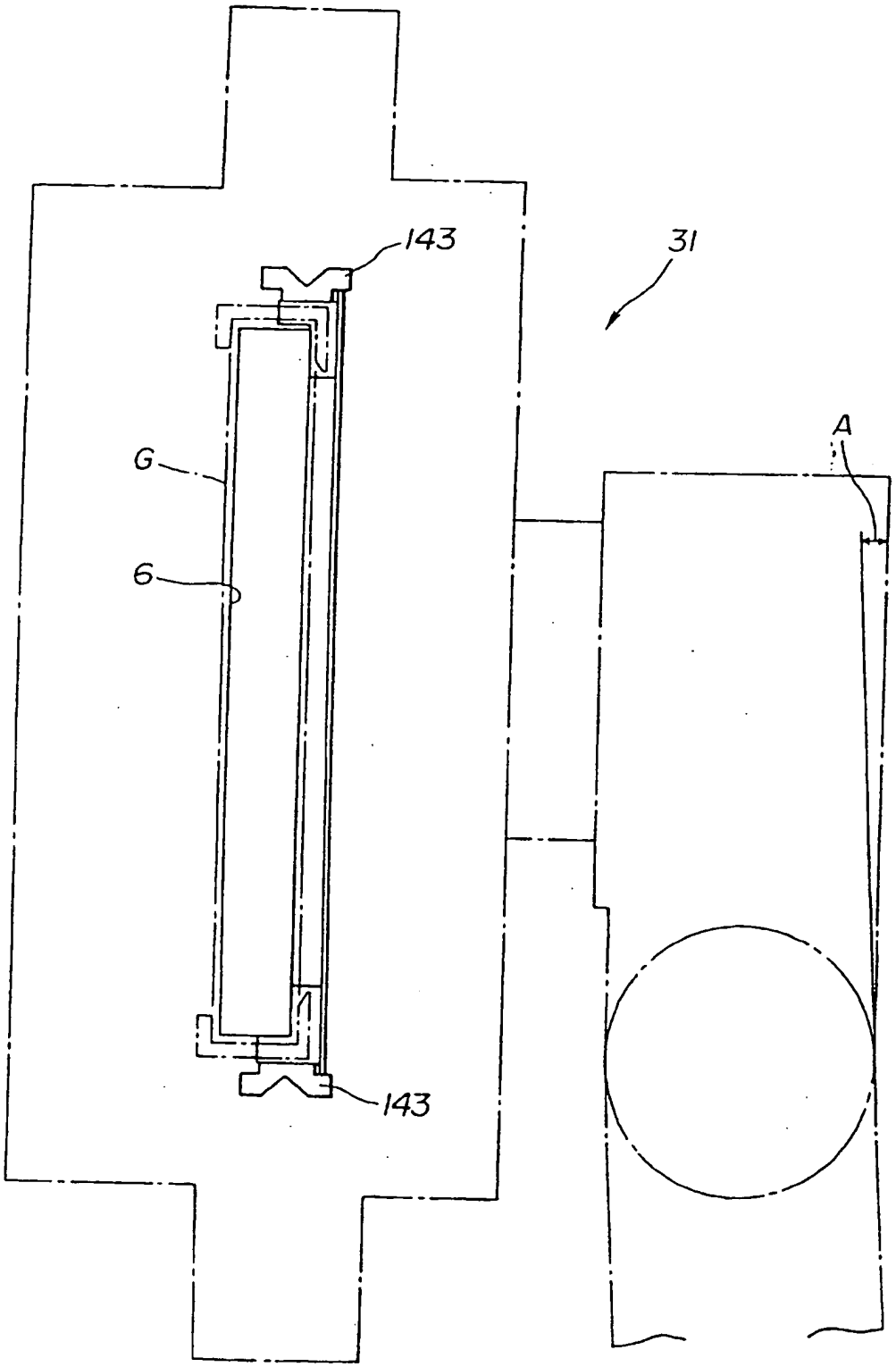


FIG.63

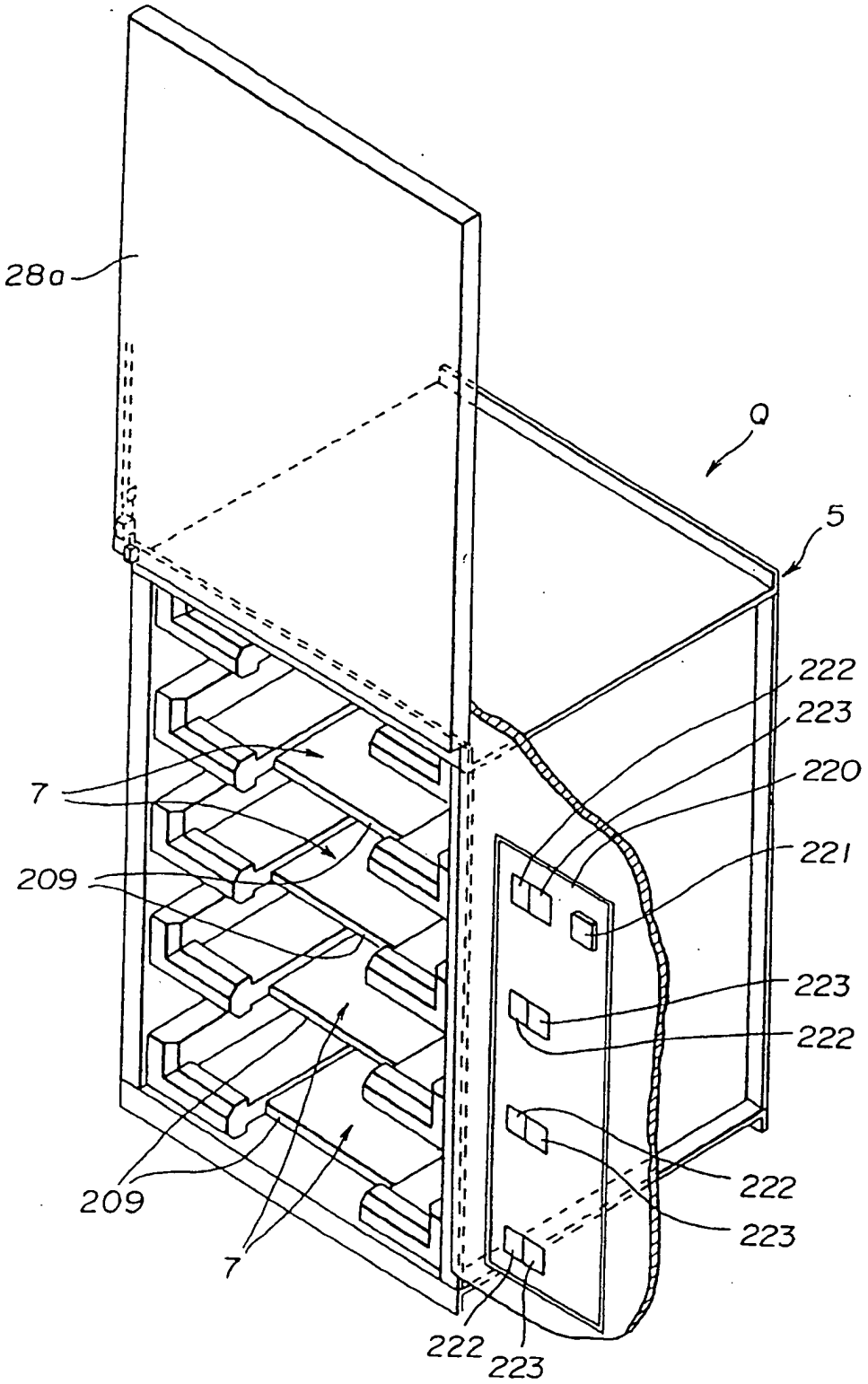


FIG.64

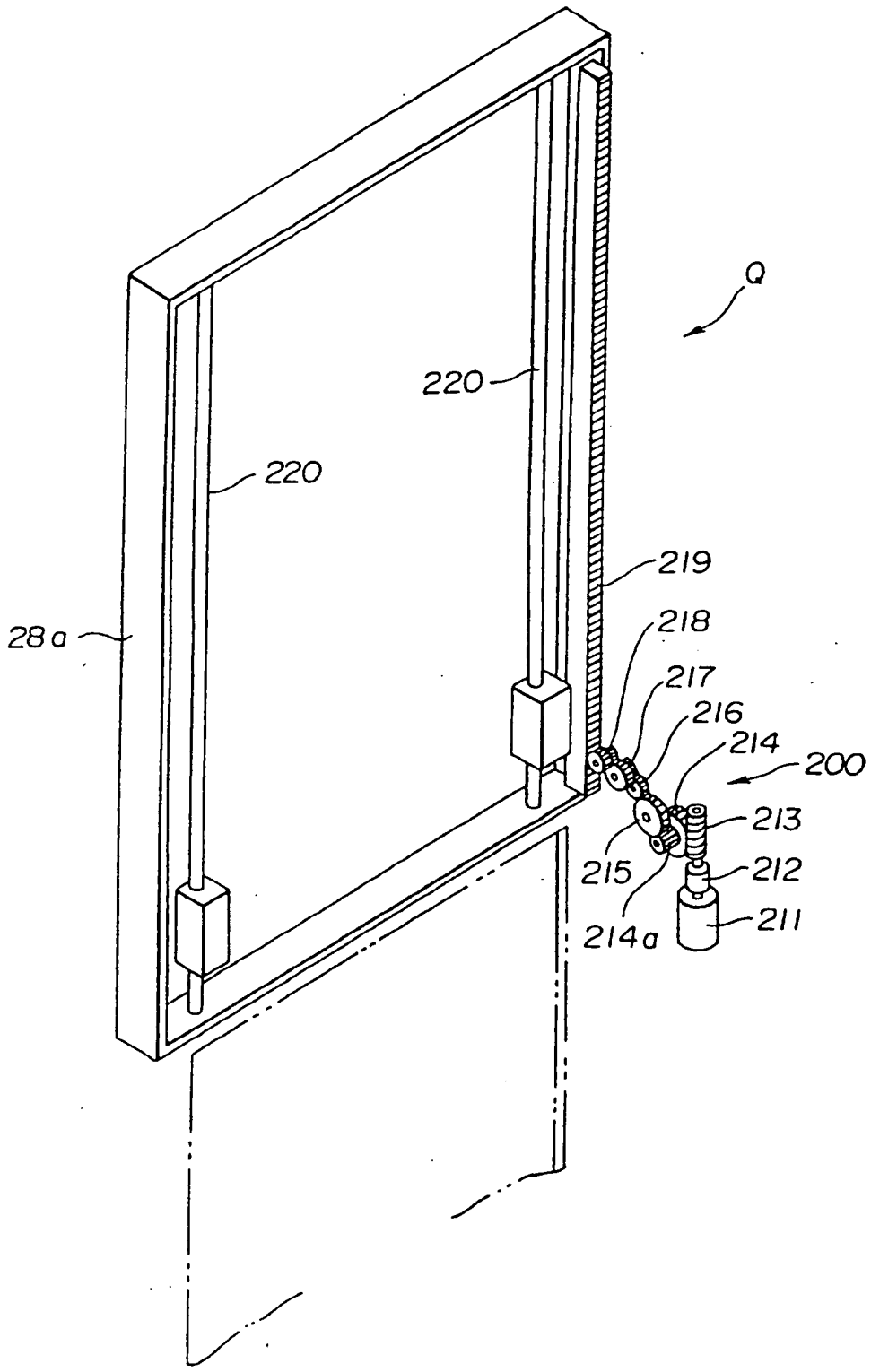


FIG.65

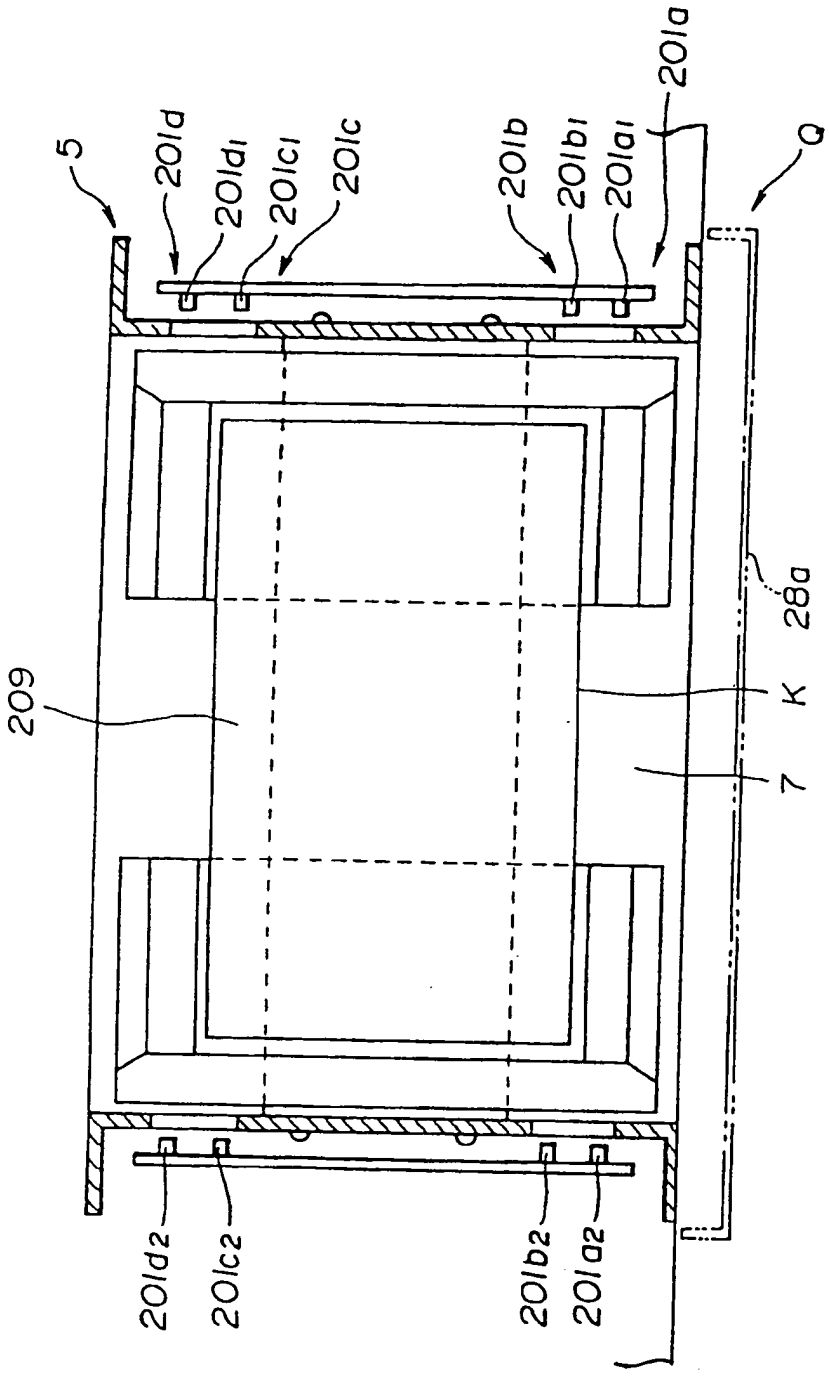

5
201d
201d1
201c1
201c
201b
201b1
201a1
201a
Q
28a
K
7
209
201d2
201c2
201b2
201a2

FIG.66

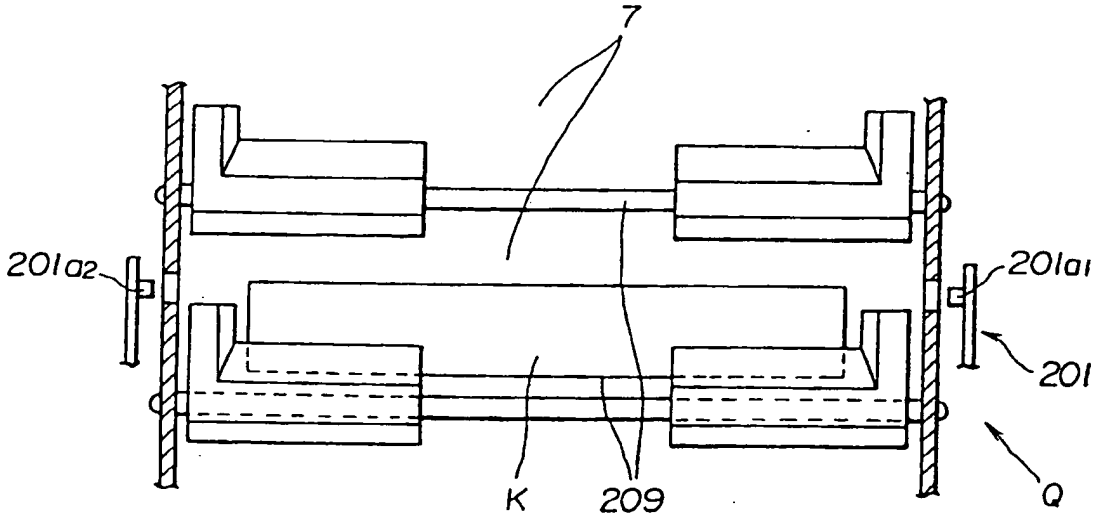


FIG.67

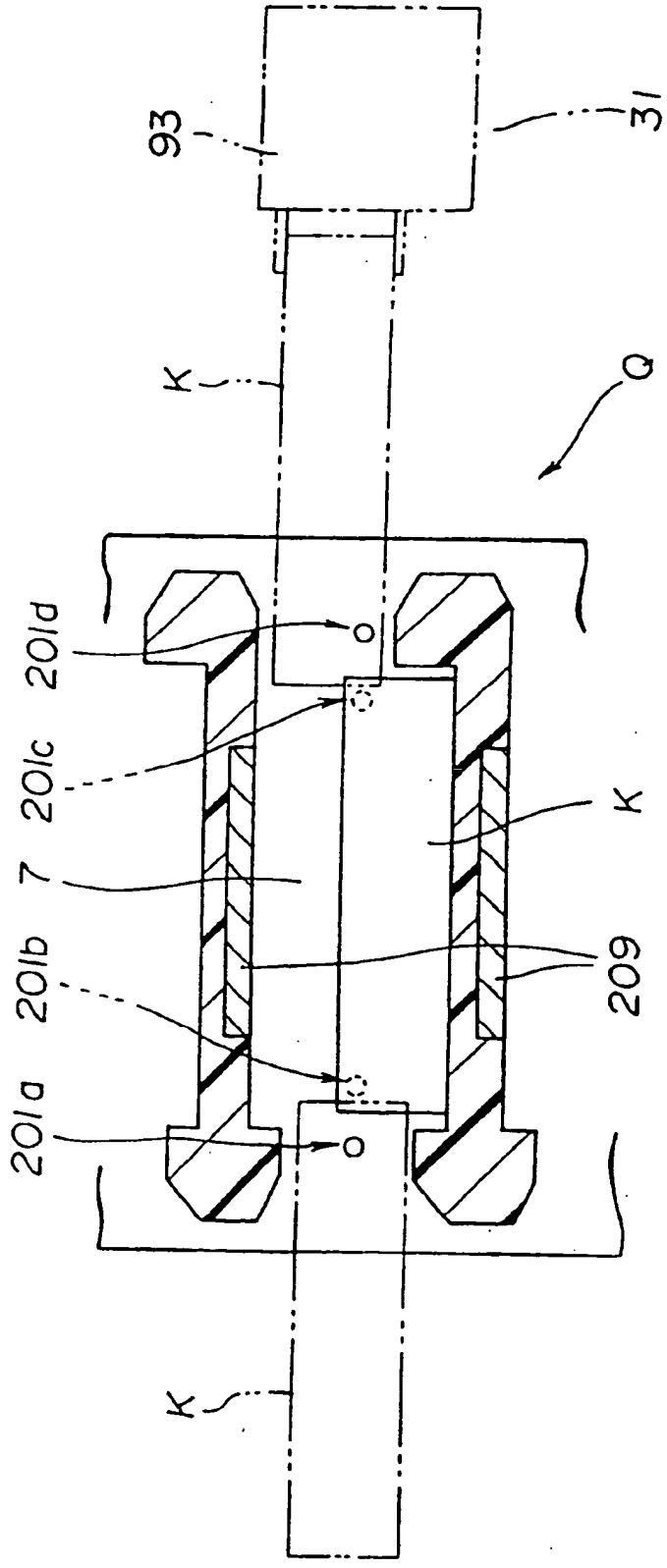
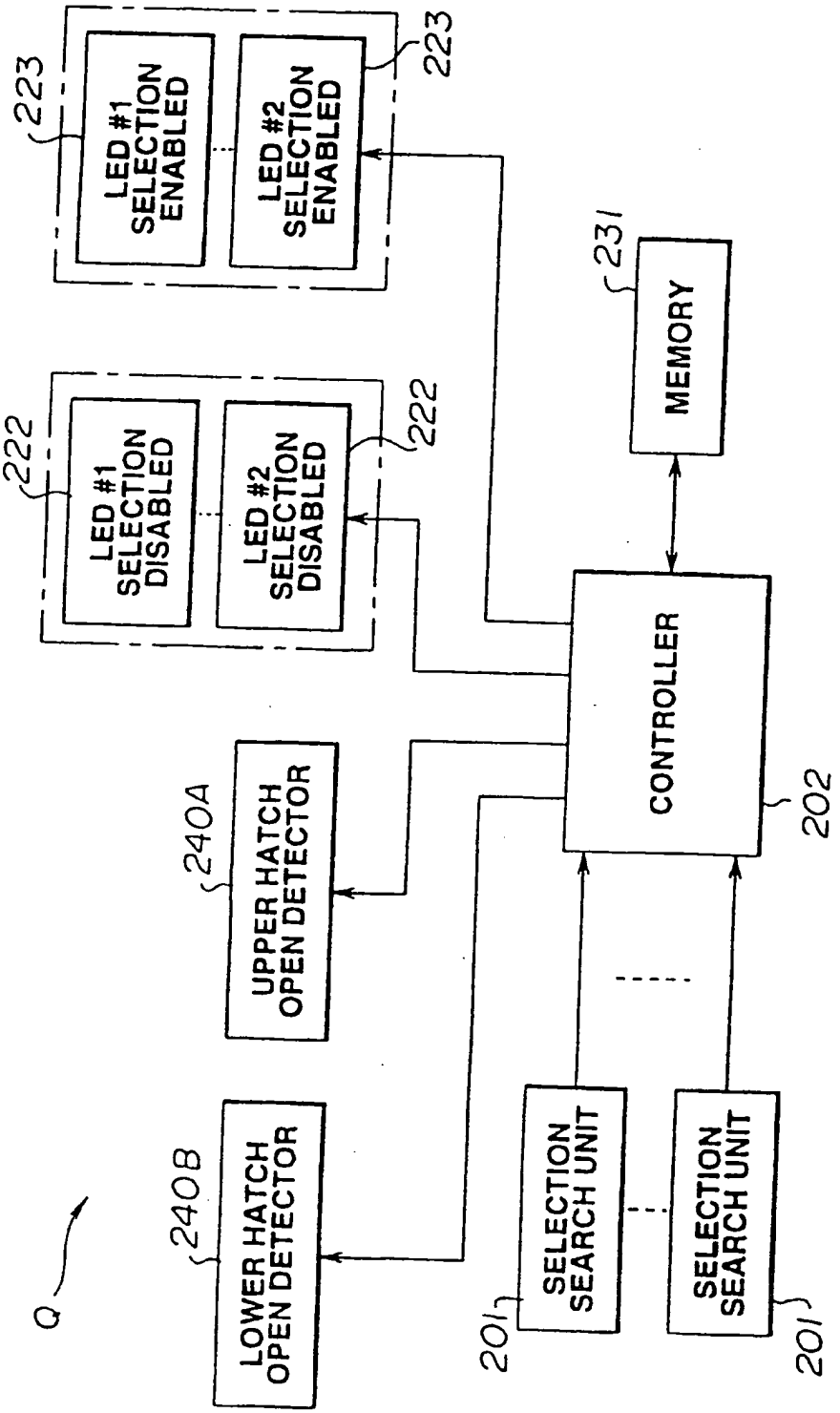


FIG.68


223
LED #1 SELECTION ENABLED
LED #2 SELECTION ENABLED
223
222
LED #1 SELECTION DISABLED
LED #2 SELECTION DISABLED
222
231
MEMORY
CONTROLLER
202
240A
UPPER HATCH OPEN DETECTOR
240B
LOWER HATCH OPEN DETECTOR
Q
201
SELECTION SEARCH UNIT
SELECTION SEARCH UNIT
201

69

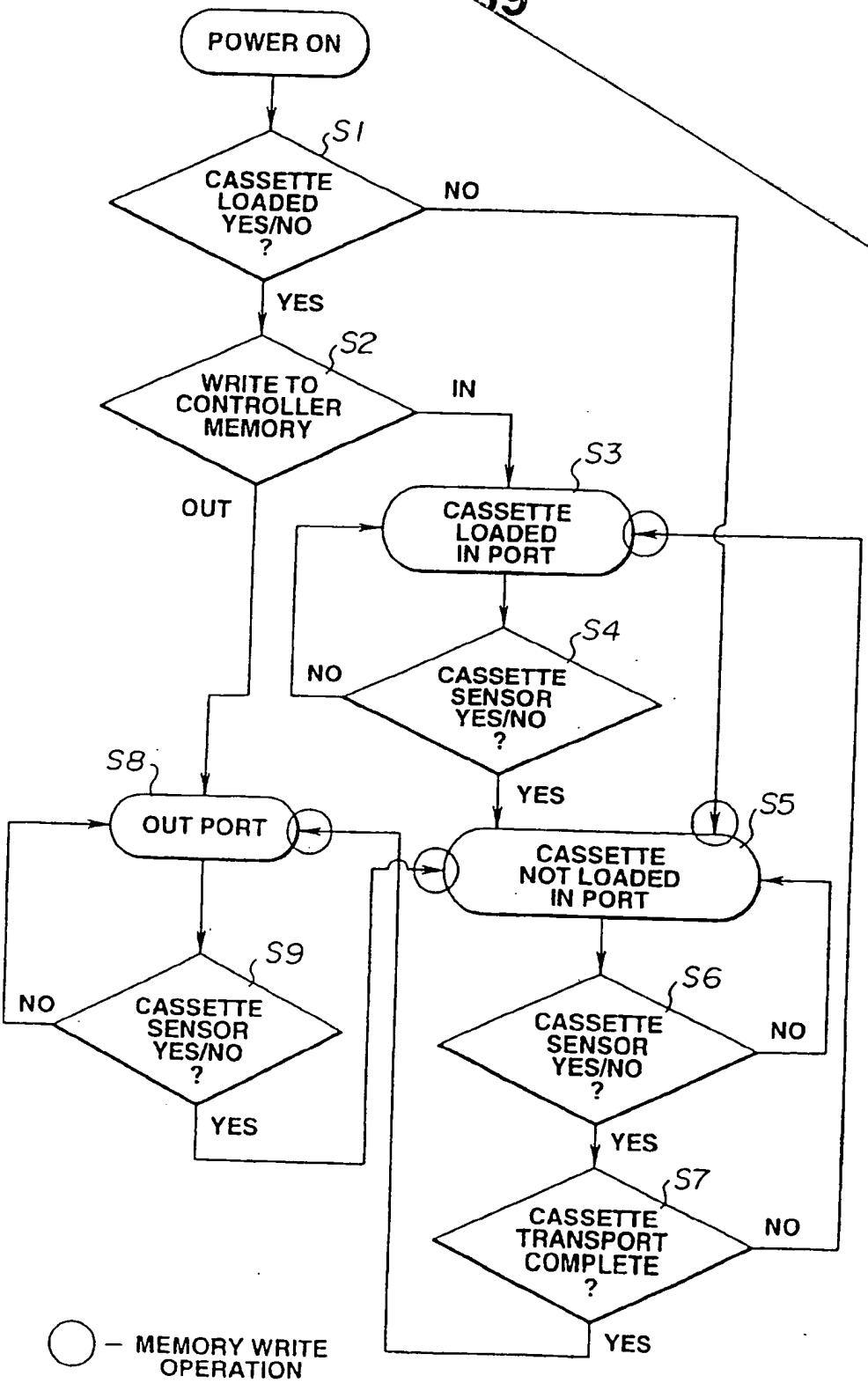

POWER ON
S1
CASSETTE LOADED YES/NO ?
NO
YES
S2
WRITE TO CONTROLLER MEMORY
IN
OUT
S3
CASSETTE LOADED IN PORT
S4
NO
CASSETTE SENSOR YES/NO ?
YES
S8
OUT PORT
S5
CASSETTE NOT LOADED IN PORT
S9
NO
CASSETTE SENSOR YES/NO ?
YES
S6
CASSETTE SENSOR YES/NO ?
NO
YES
S7
CASSETTE TRANSPORT COMPLETE ?
NO
YES
– MEMORY WRITE OPERATION

FIG.70

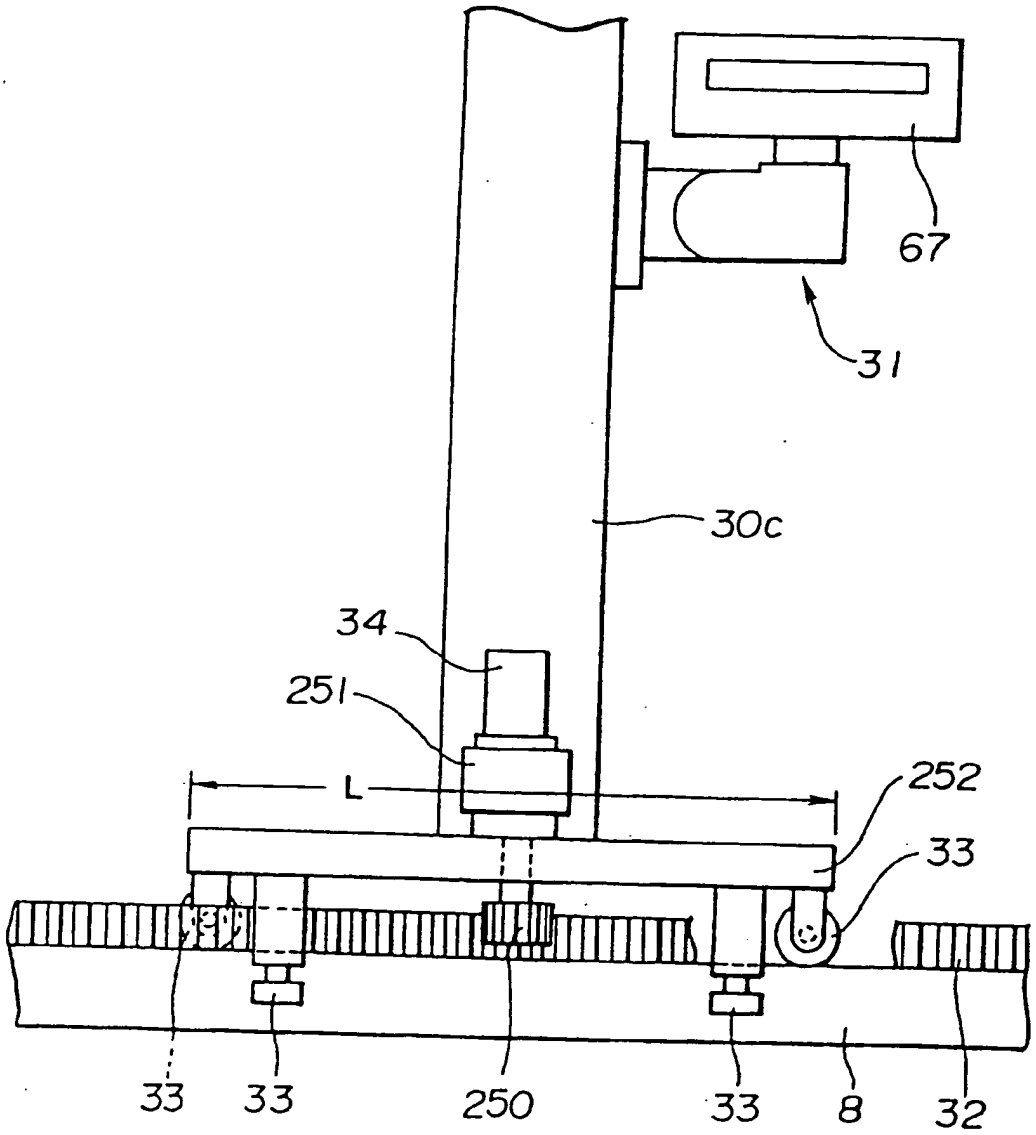


FIG.71

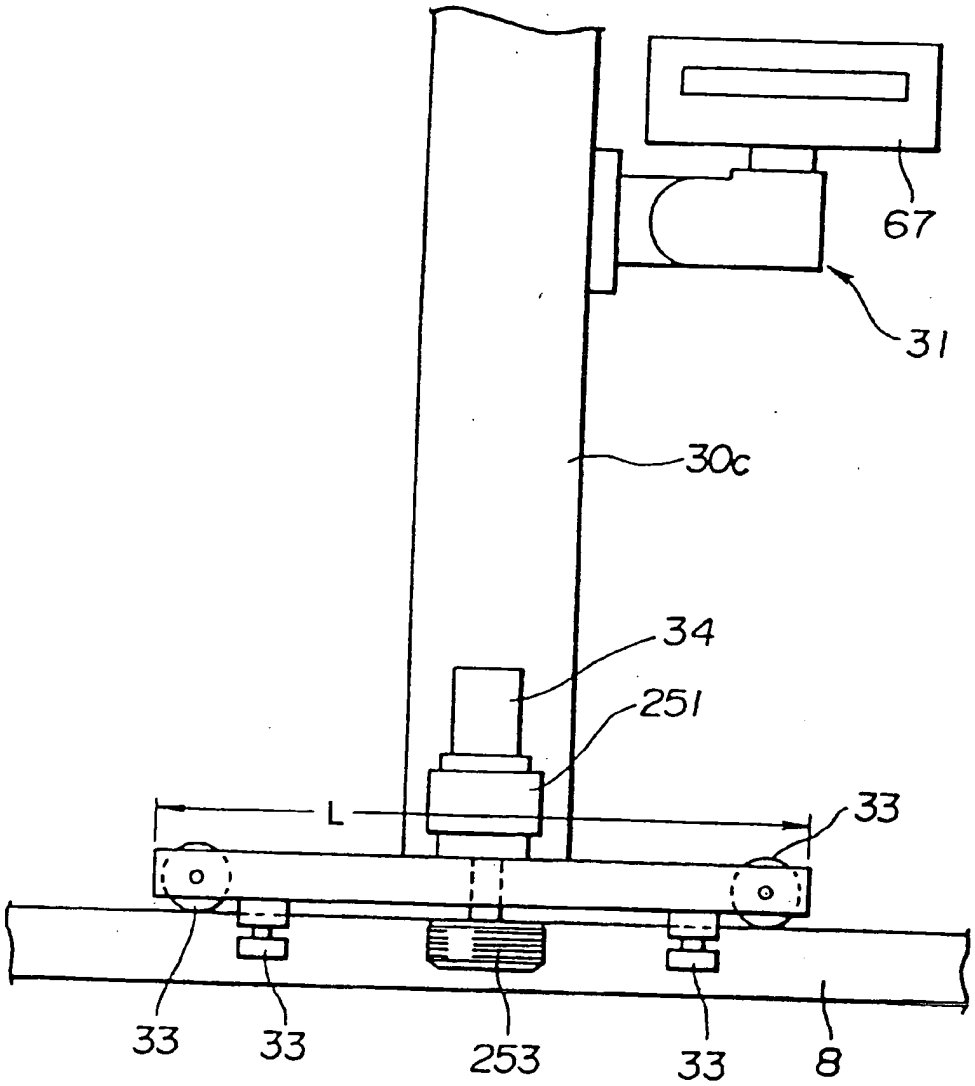


FIG.72

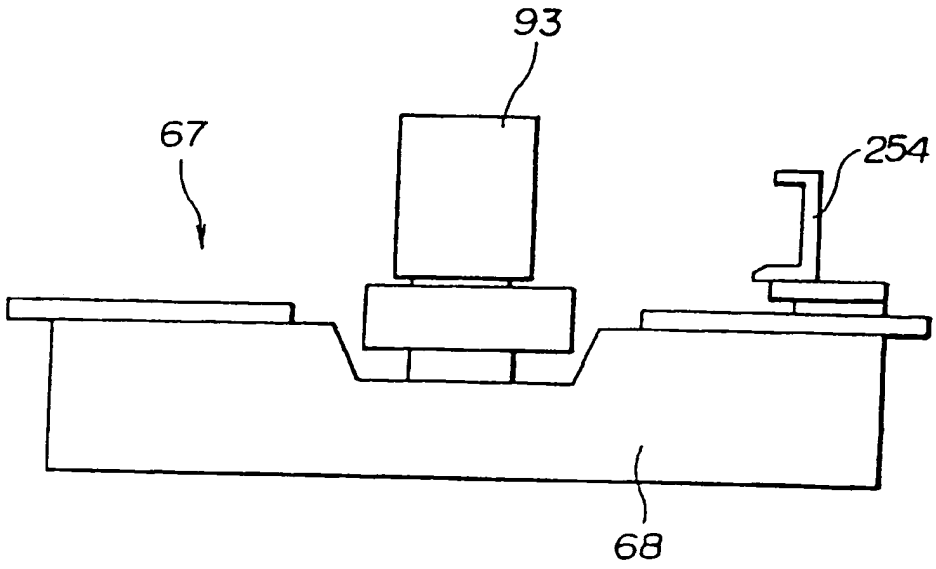


FIG.73

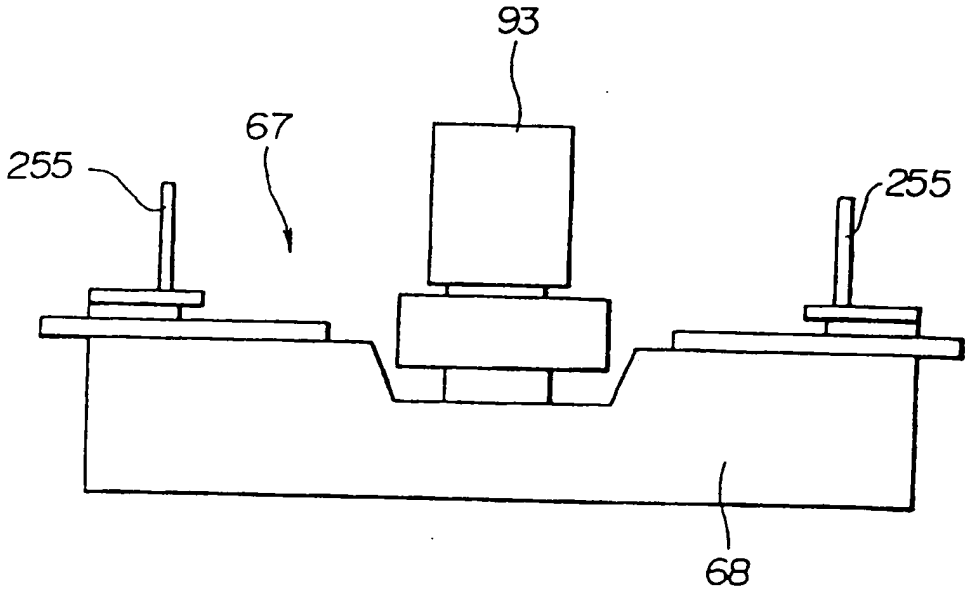


FIG.74

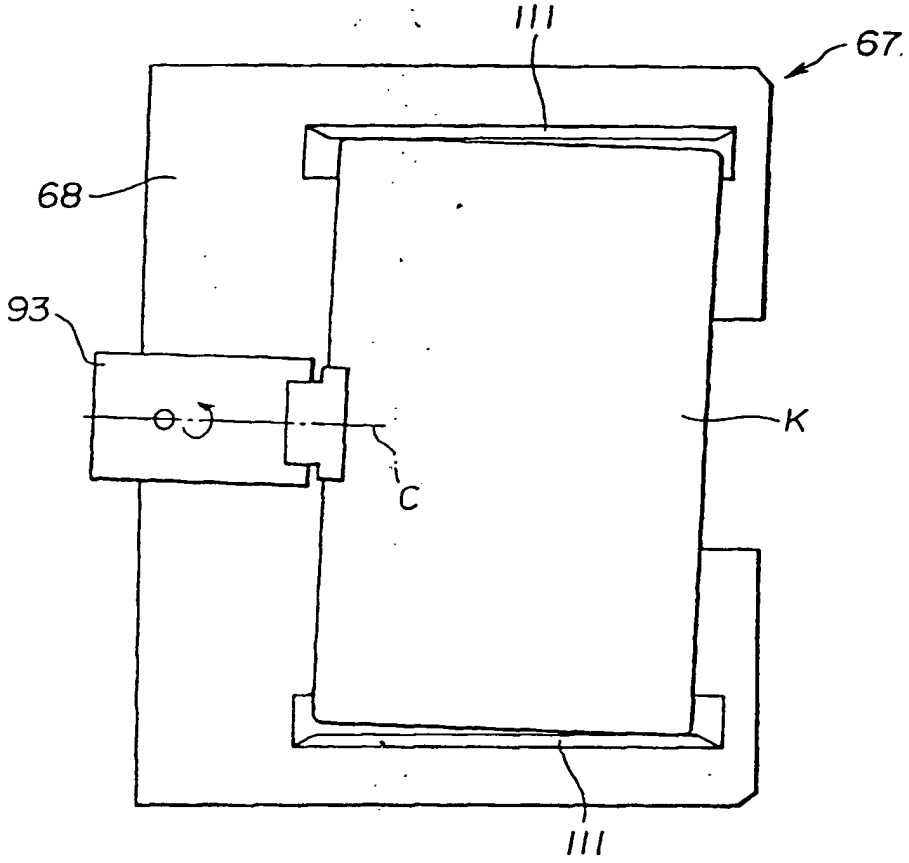


FIG.75

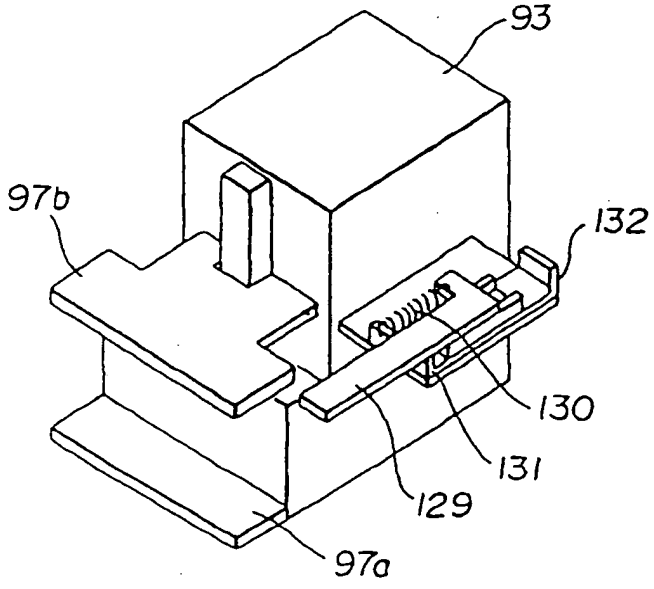


FIG.76A

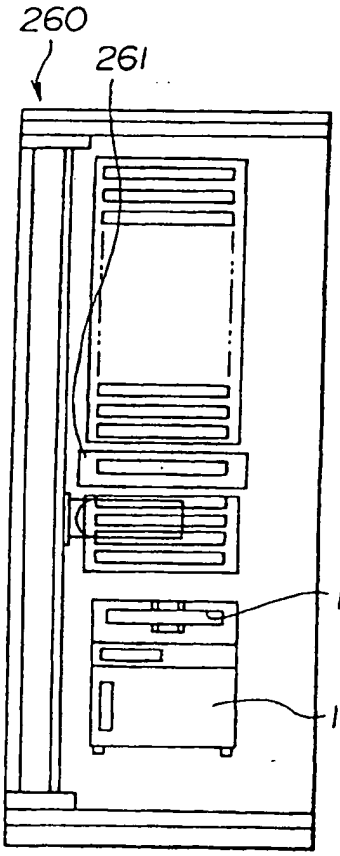


FIG.76B

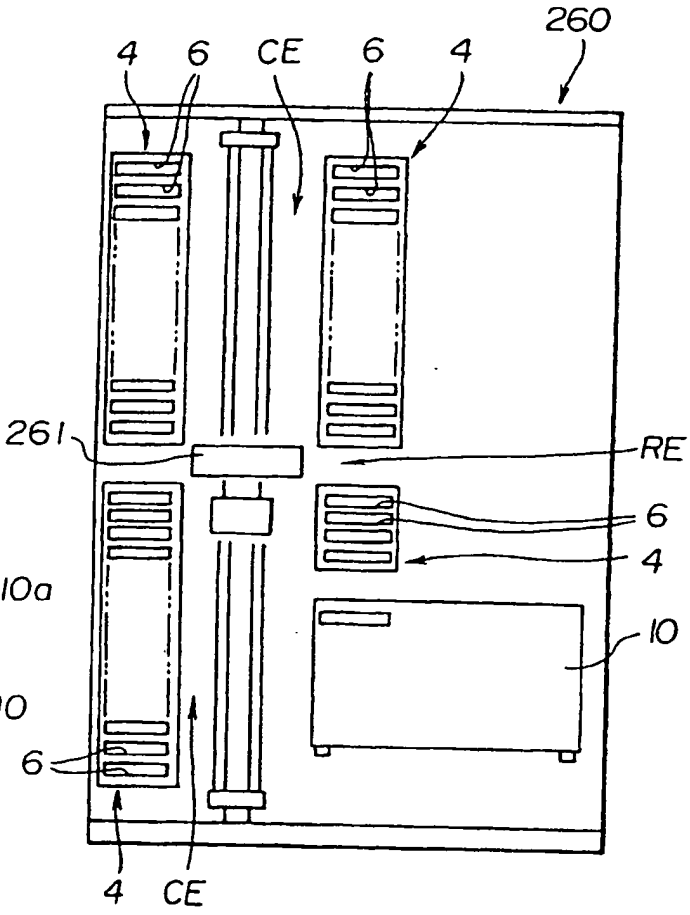


FIG.77A

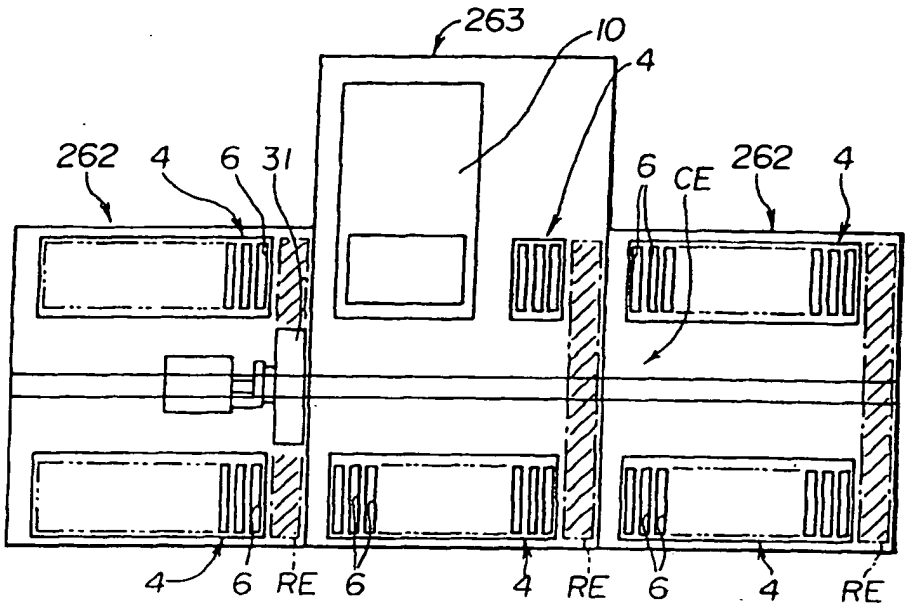


FIG.77B

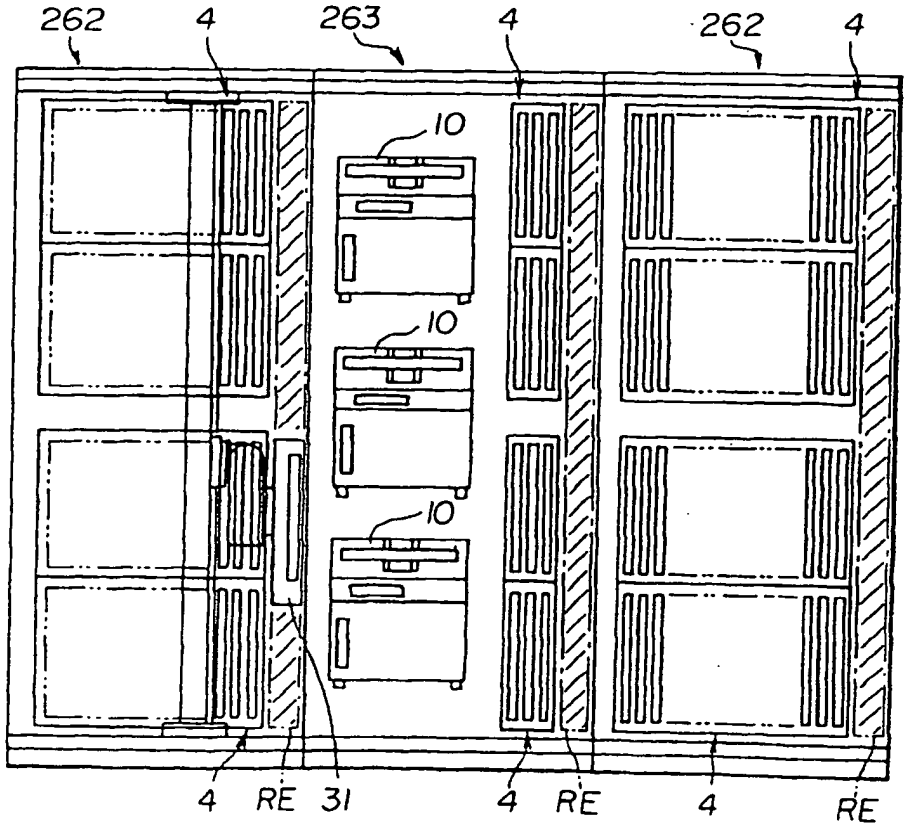


FIG.78

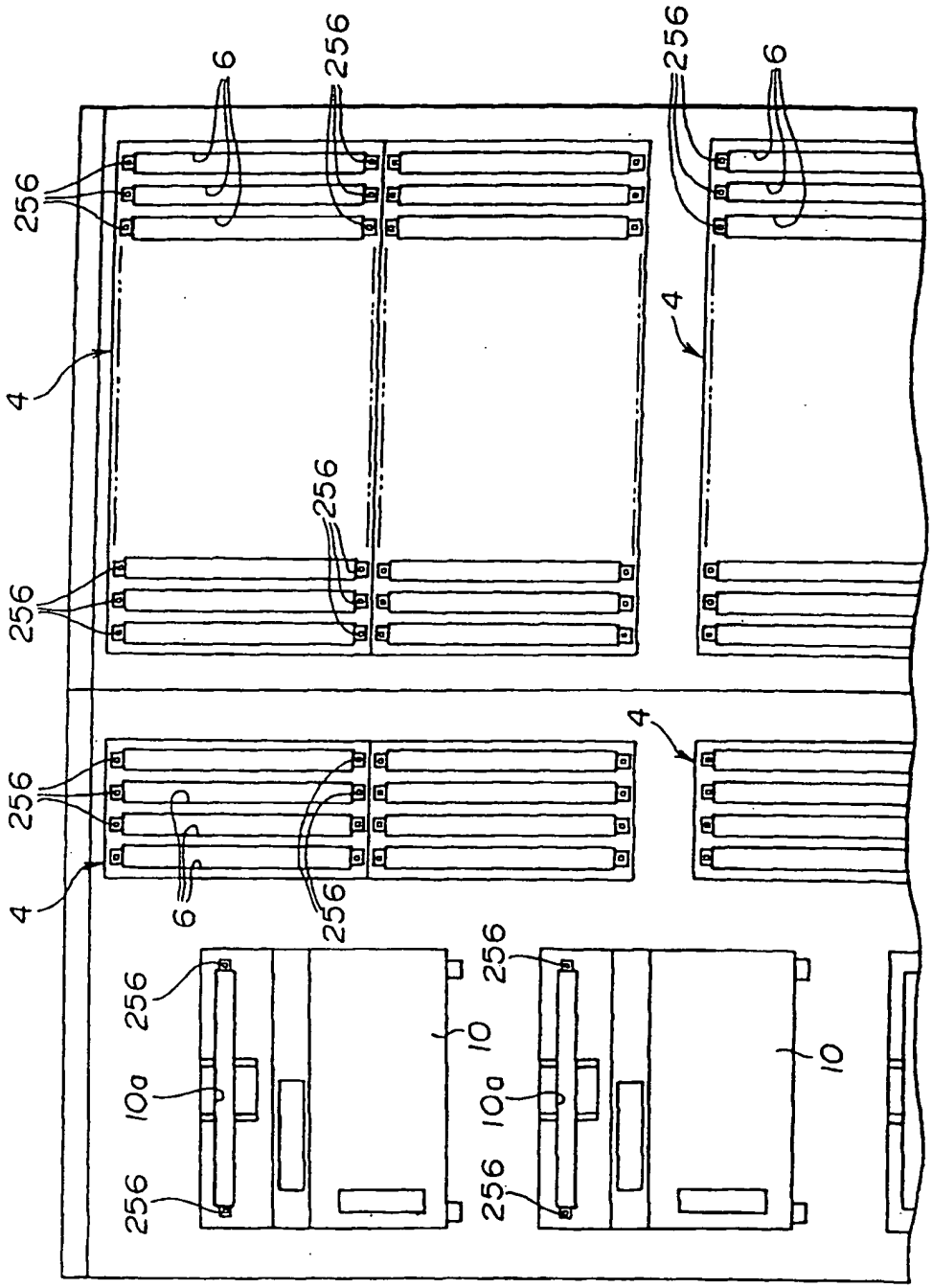

6
256
256
6
256
4
4
256
256
256
4
4
6
256
256
256
10
10
10a
10a
256
256

FIG.79

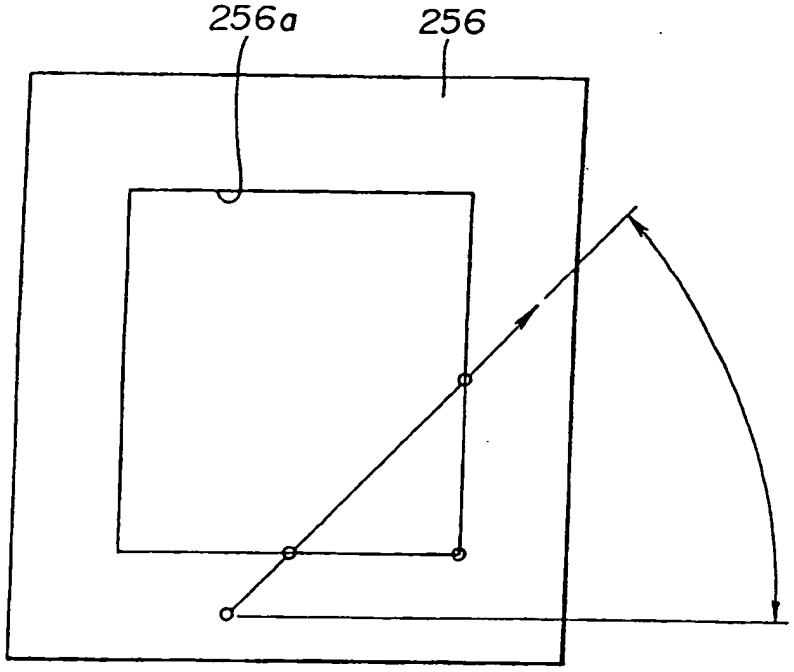


FIG.81

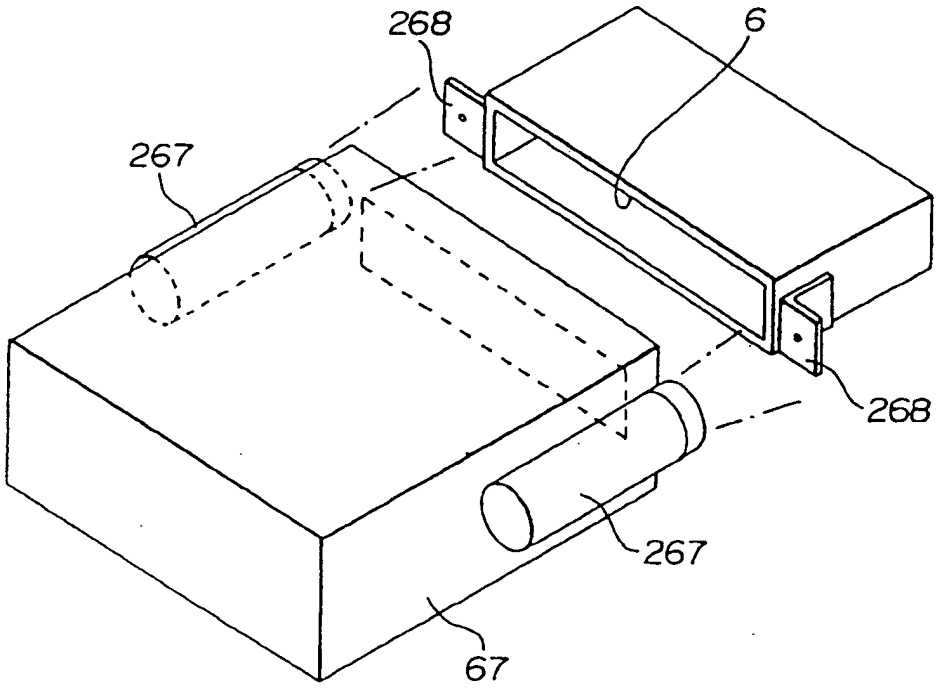


FIG.80

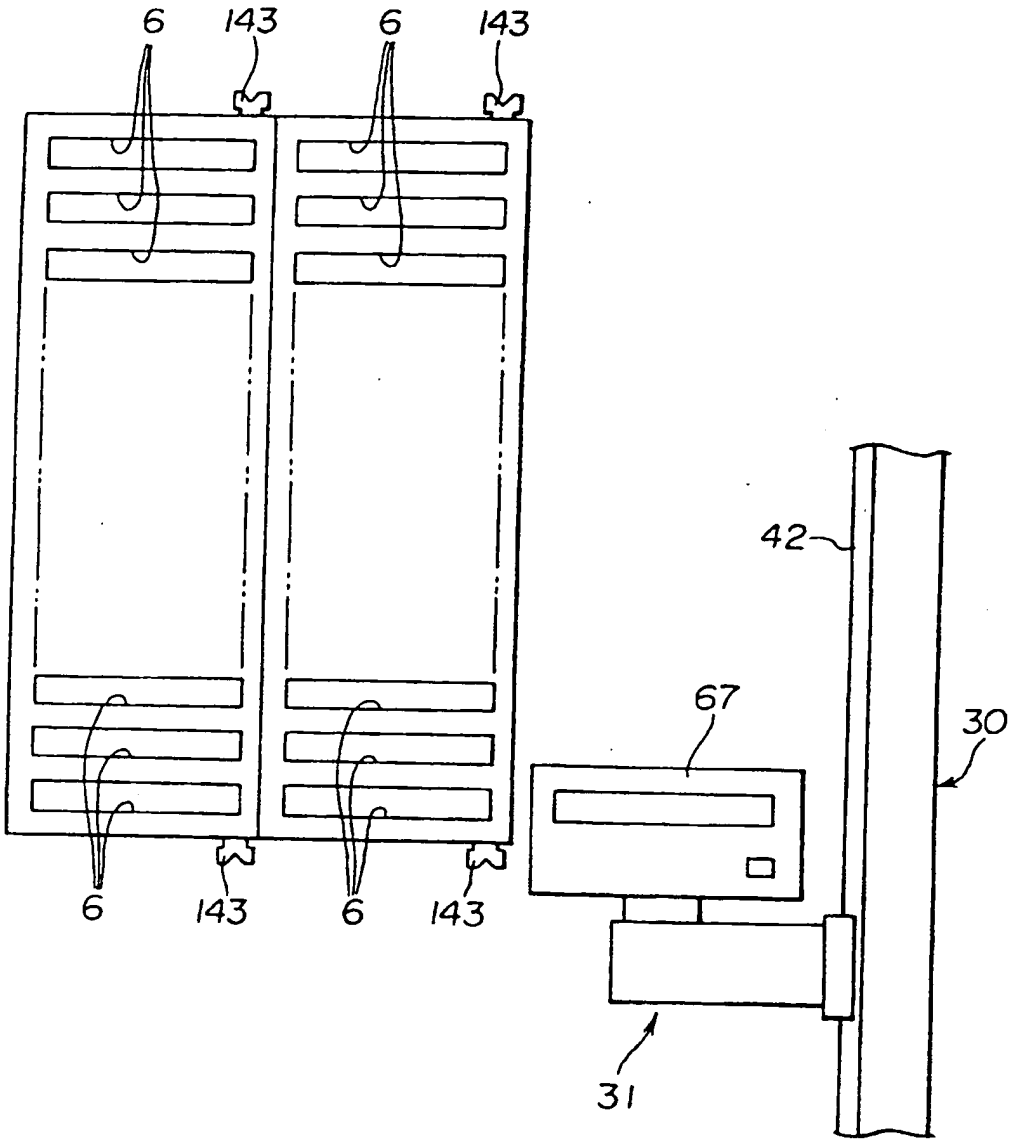


FIG.82
(PRIOR ART)

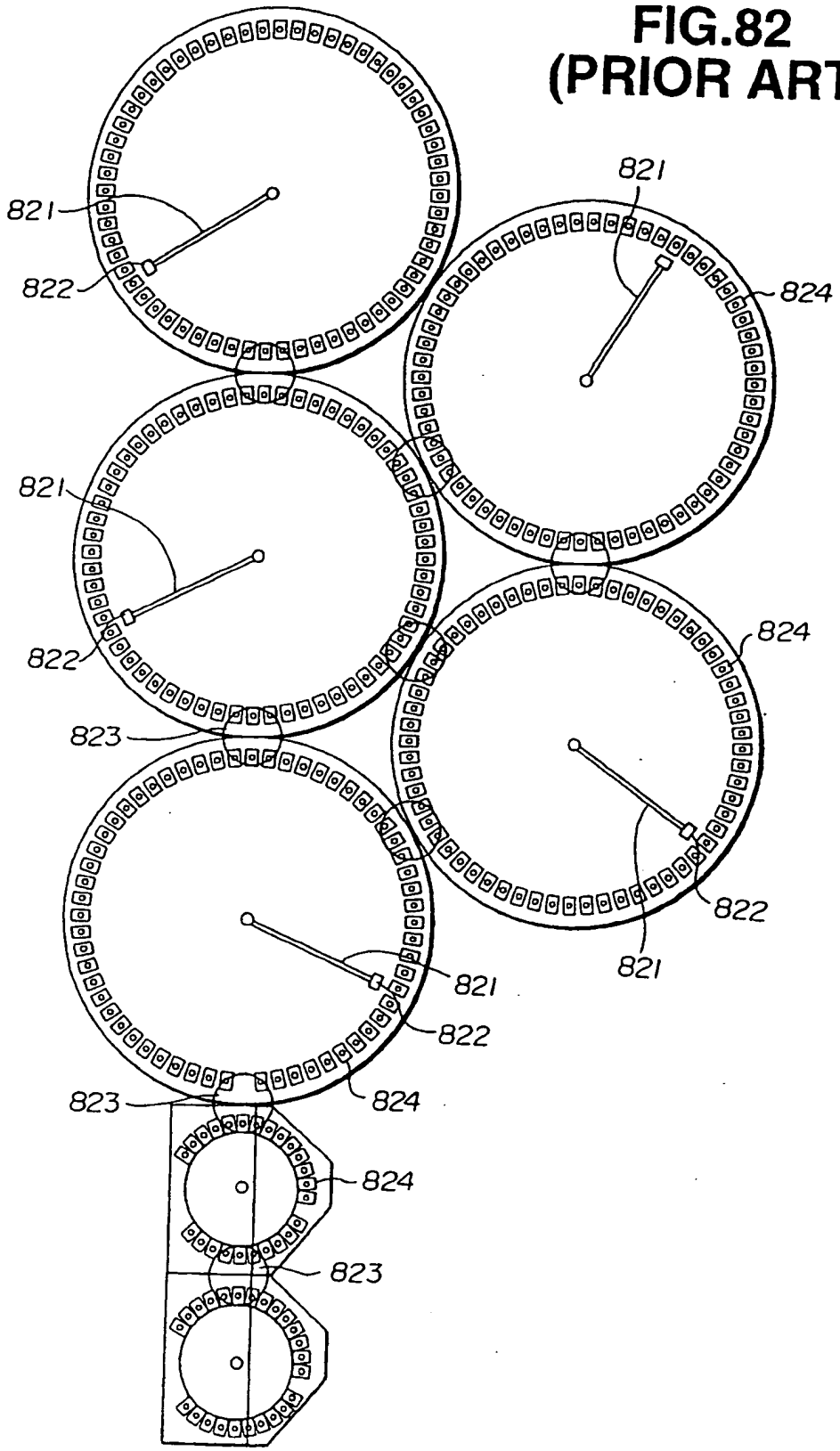


FIG.83
(PRIOR ART)

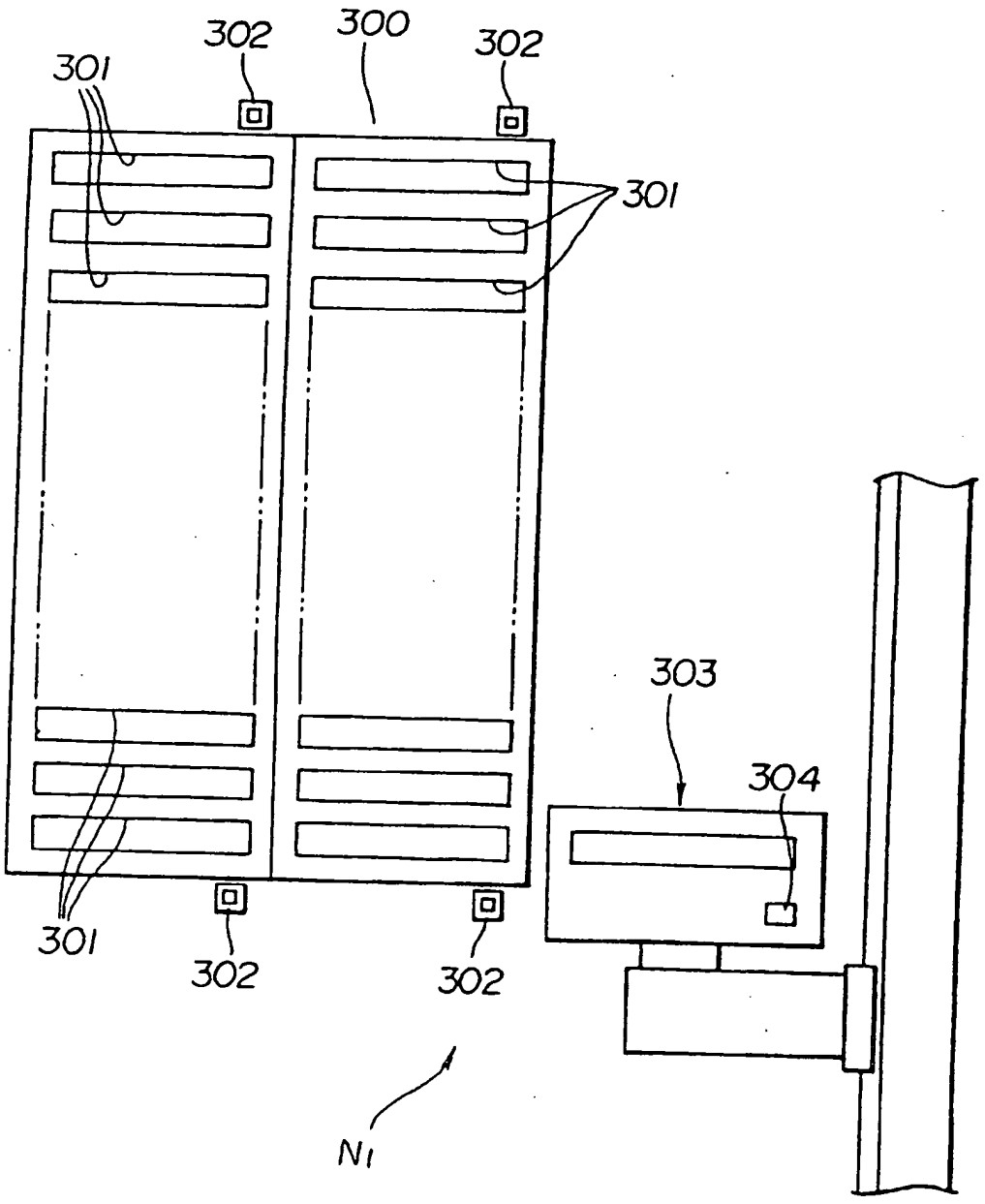


FIG.84
(PRIOR ART)

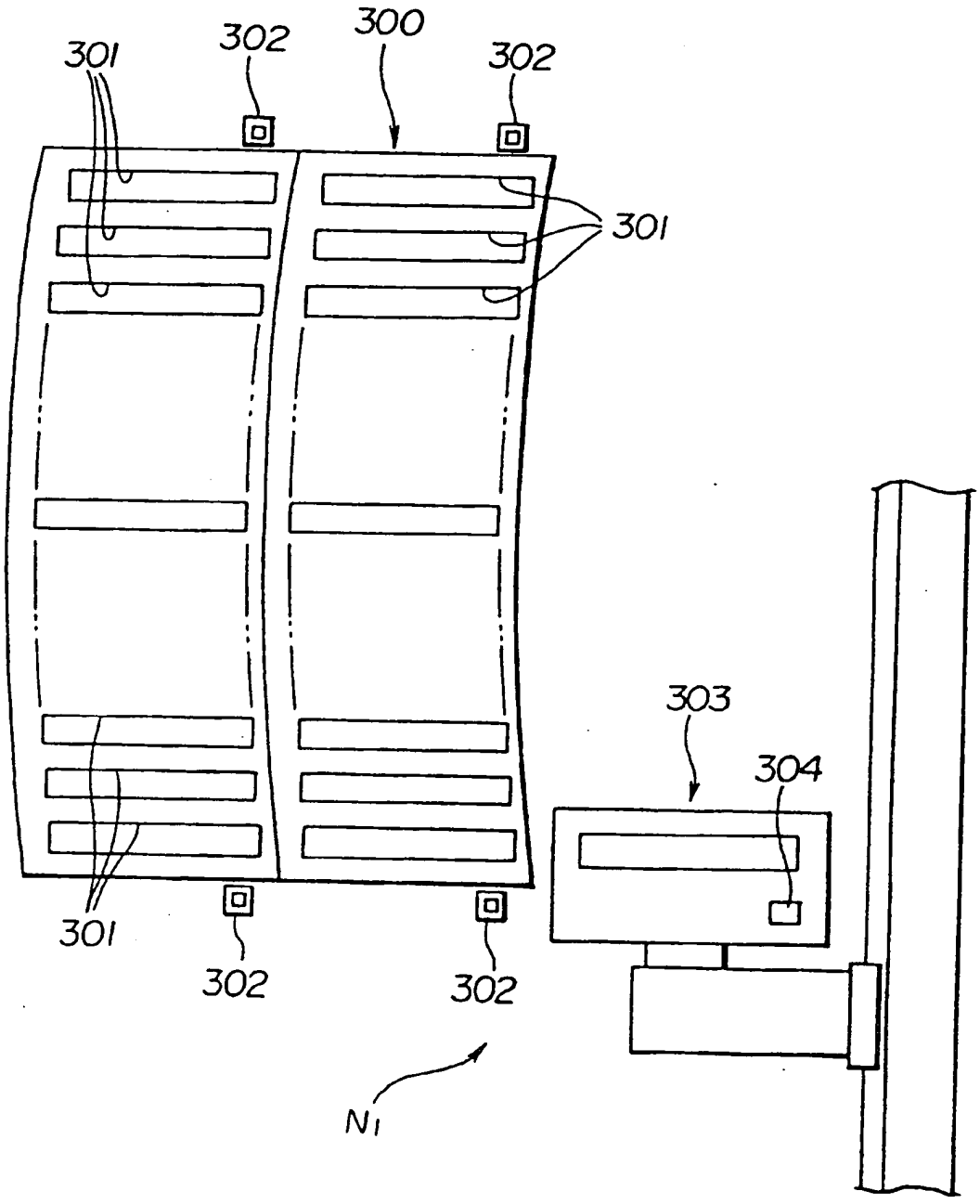
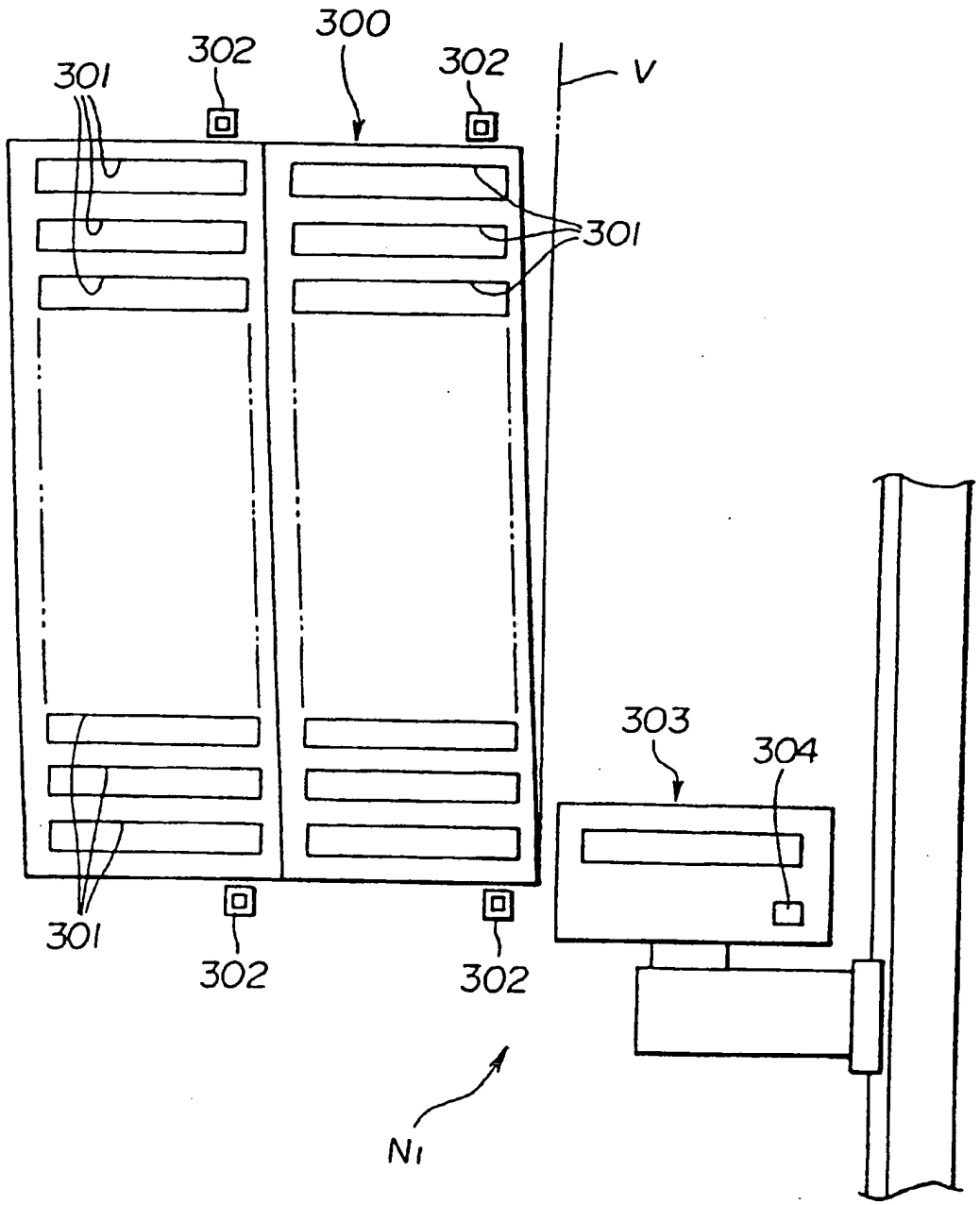


FIG.85
(PRIOR ART)



CASSETTE AUTO CHANGER SYSTEM INCLUDING TAPE SIGNAL READING MEANS AND SELECTION MEANS FOR SELECTING BETWEEN A PLURALITY OF CASSETTES

BACKGROUND OF THE INVENTION

The present invention relates to an auto changer device. Specifically, the present invention relates to an auto changer which may be utilized for automatically changing cassettes in a tape deck or the like.

DESCRIPTION OF THE RELATED ART

Generally, auto changer devices for tape cassettes are known which are used for automatically changing a tape such as an audio cassette, when a currently playing tape has been fully played and another or a plurality of other tapes is installed provided in the changer device.

One such conventional auto changer device is know for example from Japanese Laid Open Patent Application No. 1-243265. Operation of such a conventional auto changer device will be described below with reference to FIGS. **82–85**.

First, referring to FIG. **82**, a plan view of an arrangement of cassette consoles according to the conventional arrangement is shown. As may be seen the consoles are circular in shape holding a plurality of cassettes in slots accessible from a peripheral surface thereof. Cassette selection is effected via a rotation arm **821** and a cassette transfer mechanism **822** associated therewith. According to this structure however, it is difficult to assure exact positional alignment between a cassette transport portion and the circular cassette consoles during tape selection operations and the like. Further, when a plurality of consoles is implemented, it is necessary to provide a separate tape transport mechanism including a cassette receiving transfer component between each Thus, the cost and complexity of the auto changer unit becomes high. In addition, the above described arrangement requires a relatively large amount of space for mounting such circular rotating consoles.

Also, in such an arrangement, in addition to the above mentioned components, a console for mounting a cassette playing device and/or cassette compartments including driving means therefor must be provided. Further, a position detection apparatus must be utilized to assure correct alignment of components during tape transfer operations. For example, such a position detection means may be a photoelectric cell mounted proximate a tape shuttle compartment for monitoring a position of the tape transport mechanism.

Referring to FIG. **83**, a diagram of such a positional detection means as implemented in the conventional cassette auto changer as described above is shown. As may be seen the detection portion, is positioned proximate a cassette insertion rack **300** having a plurality of cassette insertion chambers **301**. The detection portion is configured as a plurality of photoelectric cells **302** provided on the cassette insertion rack. While a movable cassette transport portion **303** within the casing of the auto changer device includes a photoelectric sensor, or the like, **304** thereon. The photoelectric sensor **304** is provided for detecting optimum alignment with a particular photoelectric cell **302** for facilitating calculation of an optimal positional relation between the cassette transport portion **303** and a given one of the cassette insertion chambers **301**.

However, according to such arrangement, it is difficult to calculate the exact positional relation between the cassette transport portion and a selected cassette provided in one of the cassette insertion chambers **301** of the cassette rack **300** owing to the contours of the cassette rack. For example, in FIGS. **84** and **85**, since the cassette rack **300** in the first case is rounded at an outer surface portion while the latter is tapered, or V-shaped, it becomes difficult to calculate positioning between a cassette and a cassette transport component with high accuracy. Further, according to such arrangement as seen in FIG. **85**, rotation of the cassette rack **300** according to cassette selection operation makes accurate determination of a stop position difficult according to the conventional positional detection means.

Thus, while such conventional arrangements require a large space for installation, an operational reliability thereof is degraded.

Further, other conventional auto changer systems have been disclosed, such as in Japanese Patent Application 05-2804 and 07-37308. According to such arrangements, a cassette out port and a cassette in port are provided. That is, ports are provided for removing cassettes from the casing of the auto changer system and inserting cassettes thereinto. However, according to such arrangements, it is not possible to use the cassette input port only. Thus, operations such as when a plurality of cassettes are to be installed into the system become cumbersome. Also, according to the above arrangement, the output port alone may not be utilized for easily removing a plurality of cassettes from the auto changer system.

Japanese Patent Application 05-2804 includes a vertically and horizontally movable cassette support portion which is freely movable according to rotational movement. According to this, timing belts must be provided in the vertical and horizontal directions as well as motors for driving a tape transfer mechanism including the cassette support portion and a larger space is required for installation and electrical usage is increased. Also, electrical cable and wiring for providing such a cassette auto changer system becomes complex.

In addition, according to an auto changer system disclosed in U.S. Pat. No. 2,075,559, a retaining lock provided in each cassette insertion chamber of a cassette rack, is designed to be released by a lock releasing mechanism provided on the cassette transfer mechanism. However, according to this, a separate driving means is required for activating a lock release lever of the cassette transfer mechanism to engage a lock lever of a cassette insertion chamber. Thus, the complexity and number of component parts is increased in addition to a basic cost for the auto changer system.

Thus it has been required to provide a compact, reliable cassette auto changing apparatus having a relatively uncomplicated structure such that manufacturing expense and complexity are minimized while assuring a highly functional unit which may be installed in a comparatively small area space.

Also, it is desirable to provide a cassette auto changer system in which is simplified and has a reduced number of components.

Reliable determination of positioning between components Is further required in such a compact cassette auto changer system.

In addition, reduced electrical requirements and simplified wiring, as well as smaller capacity cable is desirable in such an auto changer system.

Provision of cassette locking and release mechanisms which are simplified is desired.

A cassette auto changer system which may execute cassette transfer operations in a reduced space is necessary for providing a compact apparatus.

And, flexible use of port openings according to an operation desired by the user is a feature to be desired in such a cassette auto changer system.

SUMMARY OF THE INVENTION

Thus, it is an object of the present invention to overcome the drawbacks of the related art.

It is a another object of the invention to provide a compacts reliable cassette auto changer apparatus having a relatively uncomplicated structure.

It is a further object of the invention to provide a cassette auto changer system wherein manufacturing expense and complexity are minimized while assuring a highly functional unit which may be installed in a comparatively small area space.

It is a further object of the invention to provide a cassette auto changer system which is simplified and has a reduced number of components.

It is a further object of the invention to provide a cassette auto changer system wherein reliable determination of positioning between components is assured.

In addition, a further object of the invention is to provide a cassette auto changer system wherein reduced electrical requirements and simplified wiring, are provided as well as smaller capacity cable and cassette locking and release mechanisms which are simplified.

Another object is to provide a cassette auto changer system which may execute cassette transfer operations in a reduced space is necessary for providing a compact apparatus.

And, a further object is to provide a cassette auto changer system having flexible use of port openings according to an operation desired by the user.

According to one aspect of the invention, there is provided a cassette auto changer system including tape signal reading means and selection means for selecting between a plurality of cassettes, comprising: a base console including a port for tape insertion or extraction operations and having a tape insert compartment; a drive console mounting the tape signal reading means; a cassette console mounting a cassette rack including a plurality of cassette receiving compartments; and tape transfer means for transporting tape cassettes between the cassette console and the drive console.

According to another aspect of the invention, there is provided a cassette auto changer system including means for selectably providing a plurality of cassettes to be loaded into one or more tape signal reading means, comprising: a cassette rack including a plurality of cassette receiving compartments; a tape transfer mechanism operable to selectably transport cassettes between the cassette rack and the tape signal reading means: a pair of position detection portions provided in a longitudinal direction of an opening of each of the cassette receiving compartments at either side of the opening; a pair of position detection sensors provided on the tape transfer mechanism at a position substantially corresponding to a location of the position detection portions when the tape transfer mechanism is in a loading position relative to one of the cassette receiving compartments.

According to a still further aspect of the invention, there is provided a cassette auto changer system including means for selectably providing a plurality of cassettes to be loaded into one or more tape signal reading means, comprising: a cassette rack including a plurality of cassette receiving compartments; a tape transfer mechanism operable to selectably transport cassettes between the cassette rack and the tape signal reading means; wherein a pair of position detection portions provided in a longitudinal direction of an opening of each of the cassette receiving compartments at either side of the opening; a pair of position detection sensors provided on the tape transfer mechanism at a position substantially corresponding to a location of the position detection portions when the tape transfer mechanism is in a loading position relative one of the cassette receiving compartments; a pair of opposed slanted reference lines provided above each of the position detection portions and a reference position indicator therebetween; wherein in a direction perpendicular to a scanning direction of the tape transport means a positional reference line is provided, wherein, between the opposed slanted reference lines, a positional detection area and a non-detection area defined therein and a non-detection and a positional detection area are defined outside of the slanted reference lines.

Also, according to the invention, there is provided a cassette auto changer system including means for selectably providing a plurality of cassettes to be loaded into one or more tape signal reading means, comprising: a cassette rack including a plurality of cassette receiving compartments; a cassette port accessible from an outer side of the auto changer apparatus whereby cassettes may be inserted or removed from the auto changer apparatus; a tape transfer mechanism operable to selectably transport cassettes between the cassette rack and the tape signal reading means and the cassette port; a YES/NO sensor at the cassette port for determining whether a cassette is present in the cassette port; and control means active such that, when a YES indication determined by the YES/NO sensor changes to a NO determination, the control means sets the cassette port at an IN port empty condition and, when in such IN port empty condition the YES/NO sensor changes to a YES condition wherein a cassette is present in the cassette port, operation of the tape transfer mechanism to the cassette port is disabled and an IN port loaded condition is determined, and when, in an IN port empty condition of the cassette port, operation of the tape transfer means is detected by the YES/NO sensor, the control means determines an OUT port loaded condition of the cassette port, and when in the OUT port loaded condition a change from YES to NO is determined by the YES/NO sensor, an IN port empty condition of the cassette port is determined by the control means.

In addition, according to a still further aspect of the invention, there is provided a cassette auto changer system including means for selectable providing a plurality of cassettes to be loaded into one or more tape signal reading means, comprising: a cassette rack including a plurality of cassette receiving compartments; a tape transfer mechanism operable to selectably transport cassettes between the cassette rack and the tape signal reading means; wherein at least horizontal rotation of a movable cassette shuttle body of the tape transfer mechanism is possible; and a transfer area whereat up/down movement of the tape transfer mechanism is possible; a rotation area is defined for allowing rotation of the cassette shuttle body of the tape transfer mechanism.

Another aspect of the invention provides a cassette auto changer system including means for selectably providing a plurality of cassettes to be loaded into one or more tape signal reading means comprising: a cassette rack including a plurality of cassette receiving compartments; a tape transfer mechanism operable to selectably transport cassettes between the cassette rack and the tape signal reading means;

a console portion of the cassette includes horizontally disposed guide rails at upper and lower sides of the cassette rack; and an electrically conductive rail disposed proximate the horizontally disposed guide rails; wherein a cassette shuttle body of the tape transfer mechanism is movable along the guide rails via the electrically conductive rail.

And, a still further aspect of the invention, there is provided a plurality of cassettes to be loaded into one or more tape signal reading means, comprising: a cassette rack including a plurality of cassette receiving compartments; a tape transfer mechanism operable to selectably transport cassettes between the cassette rack and the tape signal reading means; a cassette supporting shuttle body, operably associated with the tape transfer mechanism; wherein the cassette supporting shuttle body is rotatably movable in both horizontal and vertical directions.

According to a yet another aspect of the invention, there is provided a cassette auto changer system including means for selectably providing a plurality of cassettes to be loaded into one or more tape signal reading means, comprising: a cassette rack including a plurality of cassette receiving compartments; a tape transfer mechanism operable to selectably transport cassettes between the cassette rack and the tape signal reading means; a cassette supporting shuttle body, operably associated with the tape transfer mechanism; and a cassette hand portion connected with the cassette supporting shuttle body operable to effect extraction operation from a selected one of the cassette receiving compartments of the cassette rack; wherein the cassette hand portion further includes an unlock lever, engageable with a corresponding lock lever of the cassette receiving compartments for effecting an unlocked state of the cassette receiving compartment during engagement with the cassette hand portion for facilitating the extraction operation.

Additionally, one aspect of the invention provides a cassette auto changer system including means for selectably providing a plurality of cassettes to be loaded into one or more tape signal reading means, comprising: a cassette rack including a plurality of cassette receiving compartments; a tape transfer mechanism operable to selectably transport cassettes between the cassette rack and the tape signal reading means; upper and lower guide rails disposed at an upper side of the auto changer system; a horizontally movable slider portion of the tape transfer mechanism disposed above the guide rails; a cassette shuttle body movable along a vertical path intersecting a horizontal path of the slider portion; and driving means for the cassette shuttle body also acting as driving means for the horizontally movable slider portion.

And also, according to the invention, there is provided a cassette auto changer system including means for selectably providing a plurality of cassettes to be loaded into one or more tape signal reading means, comprising: a cassette rack including a plurality of cassette receiving compartments; a tape transfer mechanism operable to selectably transport cassettes between the cassette rack and the tape signal reading means; the tape transfer mechanism including a cassette supporting shuttle body including an opposed pair of cassette guide portions engageable with opposed side portions of a cassette disposed in a selected cassette receiving compartment of the cassette rack; centering means for driving the cassette guide portions in left and right directions in relation to an axis thereof for effecting centering operation of the cassette guide portions.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an perspective view of a preferred embodiment of an auto changer device according to the invention;

FIG. **2**(*a*) shows a plan view of a main portion of a base console of the device while FIG. **2**(*b*) shows a front view thereof;

FIG. **3**(*a*) is a left side view of the device of the embodiments and FIG. **3**(*b*) is a right side view thereof;

FIG. **4**(*a*) is an enlarged plan view of a drive console portion of an auto changer device according to the embodiment, FIG. **4**(*b*) shows a front view thereof;

FIG. **5***a* is a cross-sectional view of the auto changer device taken along line a—a of FIG. **4**(*a*), FIG. **5**(*b*) shows a right hand side view of the drive of the auto changer according to the embodiment;

FIG. **6**(*a*) is a plan view of a cassette console of the preferred embodiment while FIG. **6**(*b*) shows a front view thereof;

FIG. **7**(*a*) is a cross-sectional view taken along line b—b of FIG. **6**(*a*), FIG. **7**(*b*) shows a right side view of the cassette console;

FIG. **8**(*a*) is an enlarged plan view of a base console according to the invention and FIG. **8**(*b*) is a front view of the enlarged base console;

FIG. **9**(*a*) is a left side view of the base console of FIG. **8** and FIG. **9**(*b*) shows the right side thereof;

FIG. **10** is a partially cut away perspective view of a cassette shuttle mechanism of the auto changer device of the invention;

FIG. **11** is a plan view showing operational motion of the cassette shuttle mechanism;

FIGS. **12**(*a*) and **12**(*b*) respectively show plan and front views of a compact cassette auto changer system according to the preferred embodiment;

FIG. **13** is a plan view schematic diagram for explaining operation of the cassette auto changer in a single axial direction according to a first embodiment of the system of the invention;

FIG. **14** is a plan view schematic diagram for explaining operation of an alternative embodiment of a cassette auto changer of the invention;

FIG. **15** is a plan view schematic diagram of a first embodiment of a biaxially operable cassette auto changer;

FIG. **16** is a plan view schematic diagram of a second embodiment of a biaxially operable cassette auto changer;

FIG. **17** is a plan view schematic diagram of a third embodiment of a biaxially operable cassette auto changer;

FIG. **18** is a plan view schematic diagram of a fourth embodiment of a biaxially operable cassette auto changer;

FIG. **19** is a plan view schematic diagram of a fifth embodiment of a biaxially operable cassette auto changer;

FIG. **20** is a perspective view of a cassette transfer mechanism utilized in the system of the invention;

FIG. **21** is a cross-sectional view taken along line c—c of FIG. **20**;

FIG. **22** is a cross-sectional view taken along line d—d of FIG. **20**

FIG. **23** in an enlarged cross sectional view of a connecting structure between a transport rail and shuttle portion of the cassette transfer mechanism;

FIG. **24** is a cross sectional view taken along line e—e of FIG. **23**;

FIG. **25** is a perspective view of a driving portion of the cassette transfer mechanism;

FIG. **26** is a perspective view of an alternative structure of a driving portion of a cassette transfer mechanism;

FIG. 27 is a cross-sectional plan view of a rotational driving means of the cassette transfer mechanism;

FIG. 28 is a cross-sectional front view of the rotational driving means of FIG. 27;

FIG. 29 is a right side view of the rotational driving means;

FIG. 30 is a perspective view of a cassette support structure of the auto changer device;

FIG. 31 is a plan view of the cassette support structure of FIG. 30;

FIG. 32 cross sectional view of a rear side of a main portion of the cassette support structure;

FIG. 33 is a cut way view of a right side of the main portion of the cassette support structure;

FIG. 34 shows a perspective view of a magnetic head and mounting structure therefor, utilized in the system of the invention;

FIG. 35 is perspective view showing the structure of a cassette loading/unloading mechanism according to the invention;

FIG. 36(*a*) is a cross sectional view for explaining operation of a main portion of the head mounting structure while FIGS. 36(*b*), (*c*) and (*d*) illustrate operation of the main portion of the head mounting structure during left, right and upward positional variation thereof;

FIGS. 37(*a*) and 37(*b*) show perspective views of the configuration of a cassette rack portion of the auto changer system including a single cassette retaining portion (FIG. 37(*b*));

FIG. 38 is a front view of the cassette rack;

FIG. 39 is a side view showing operation of the cassette guide portion and a cassette receiving compartment;

FIG. 40 shows a main portion of the cassette transfer mechanism during one phase of a cassette selection operation thereof;

FIG. 41 is side view of the cassette selection operation at a second phase thereof;

FIG. 42 is side view of the cassette selection operation at a third phase thereof;

FIG. 43 is a cross-sectional plan view of a cassette conveyance operation of the cassette transfer mechanism at a first operational phase;

FIG. 44 is a cross-sectional plan view of a cassette conveyance operation of the cassette transfer mechanism at a second operational phase;

FIG. 45 is a cross-sectional plan view of a cassette conveyance operation of the cassette transfer mechanism at a third operational phase;

FIG. 46 is a front view of a cassette selection operation of the cassette transfer mechanism at a first phase of operation;

FIG. 47 is a front view of a cassette selection operation of the cassette transfer mechanism at a second phase of operation;

FIG. 48 is a front view of a cassette selection operation of the cassette transfer mechanism at a third phase of operation;

FIG. 49 is a front view of a cassette selection operation of the cassette transfer mechanism at a fourth phase of operation;

FIG. 50 is a front view of a main portion of the invention at the time of extraction of a cassette from the cassette shuttle compartment by the cassette transfer mechanism;

FIG. 51 is a front view of a main portion of the invention at the time of insertion of a cassette from the cassette shuttle compartment by the cassette transfer mechanism;

FIG. 52(*a*) and (*b*) are front views respectively showing first and second stages of a positional disengagement operation of the cassette transfer mechanism and the cassette shuttle compartment;

FIG. 53 shows a cross-sectional plan view of a relation between the tape transport mechanism and the cassette shuttle compartment during a horizontal cassette transfer operation;

FIG. 54(*a*) shows a front view of a relation between the cassette shuttle compartment and a cassette guide portion while FIG. 54(*b*) is a plan view of a relation between the cassette guide portion and a cassette shuttle mechanism of a tape playing unit;

FIG. 55 is a perspective view of a lock release mechanism of the invention;

FIG. 56 is a schematic front view illustrating a rotation area of the tape transport mechanism according to the preferred embodiment of a cassette auto changer unit according to the invention;

FIG. 57 is a partially cut-away plan view of the rotation area established for the cassette transfer mechanism shown in FIG. 56;

FIG. 58 is an enlarged view of a main portion of the cassette auto changer unit according to a preferred embodiment;

FIGS. 59(*a*)-(*c*) are an enlarged front views showing relations between the cassette shuttle compartment and a selection search portion of the auto changer unit according to operation thereof;

FIG. 60 is a schematic diagram showing the configuration of a cassette transport device utilized in the auto changer unit;

FIG. 61 shows an operational phase of a positional adjustment operation of the cassette shuttle compartment;

FIG. 62 shows a second operational phase of a positional adjustment operation of the cassette shuttle compartment;

FIG. 63 is a perspective view of a cassette receiving rack of the auto changer unit;

FIG. 64 is a perspective view of a hatch opening/closing mechanism;

FIG. 65 shows a plan view of the cassette receiving rack of FIG. 63;

FIG. 66 shows a front view of the cassette receiving rack;

FIG. 67 shows a cross-sectional view of the cassette receiving rack;

FIG. 68 is a block diagram of a cassette IN/OUT circuit according to the invention;

FIG. 69 is a flow chart for explaining an operational process of the cassette IN/OUT circuit of FIG. 68;

FIG. 70 is an enlarged front view of a main portion of a cassette transport arrangement according to an alternative embodiment of the invention;

FIG. 71 is an enlarged front view of a main portion of a cassette transport arrangement according to another alternative embodiment of the invention;

FIG. 72 is a diagram of a main portion of a cassette support arrangement according to an alternative embodiment of the invention;

FIG. 73 is a diagram of a main portion of a cassette support arrangement according to another alternative embodiment of the invention;

FIG. 74 is a diagram of a modification of the cassette support arrangement of the invention;

FIG. 75 is a perspective view of a lock disengaging mechanism for a cassette shuttle compartment;

FIG. 76(*a*) is a side view of an interior of a cassette console and, FIG. 76(*b*) shows a front view of the console interior according to a first preferred embodiment thereof;

FIG. 77(*a*) is a plan view of an interior of a cassette console according to a second embodiment thereof and FIG. 76(*b*) shows a front view of the console interior according to the second preferred embodiment thereof;

FIG. 78 is a partial front view of an interior of a fully assembled cassette auto changer unit according to the preferred embodiment;

FIG. 79 is a front view of a positional adjustment means utilized in the auto changer unit of the preferred embodiment;

FIG. 80 is an explanatory diagram of a positional adjustment means according to a first modification according to the invention;

FIG. 81 is an explanatory diagram of a positional adjustment means according to a second modification according to the invention;

FIG. 82 is a plan view of a cassette console arrangement utilized in a conventional auto changer device as known from the related art;

FIG. 83 is a schematic diagram showing a conventional arrangement of positional detection components for a cassette auto changer device;

FIG. 84 is a schematic diagram showing another conventional position detecting arrangement for a cassette auto changer; and

FIG. 85 is another schematic diagram of positional detection components of a conventional auto changer.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereinbelow, a preferred embodiment of the invention will be explained in detail with reference to the drawings. FIG. 1 is an perspective view of a preferred embodiment of an auto changer device according to the invention.

Referring to FIGS. 1–3, the auto changer system 1 according to the invention includes a base console A, a drive console B, a cassette console C, a elongate console D a cassette rack portion 7 and a tape playing or tape playing/recording device 10. Further included are a tape transfer mechanism 2, and a power supply 3 for a horizontally movable shuttle body of the tape transfer mechanism. There is another tape transfer mechanism F for transporting cassettes K to and from a playing device from the cassette console C.

FIG. 2(*a*) shows a plan view of a main portion of the base console A of the device while FIG. 2(*b*) shows a front view thereof. There may be seen in FIG. 2(*a*) and (*b*) that the tape transfer mechanism extends laterally across the base console and includes a cassette shuttle body 31. FIG. 3 shows a cassette transport area CE which is a clearance defined to allow the tape transfer mechanism 2 to selectably transport cassettes K to one or more playing devices 10.

FIG. 3(*a*) shows a left side view of the base console A and FIG. 3(*b*) is a right side view thereof. Mounted on the base console at an end of a cassette transfer area CE is a control box 3 having a small cassette bay 4 provided at upper and lower sides thereof. Each cassette bay 4 includes a plurality of cassette receiving compartments 6. A controller including electrical circuitry or the like is included therein. Also, at a front side of the cassette transfer area CE upper and lower input/output cassette bays 5 are provided at lower and upper sides of the base console to allow cassettes to be inserted into or removed from the auto changer system 1. Each cassette bay 4 includes a plurality of cassette receiving compartments 6 while each input/output cassette cassette bay 5 includes a plurality of cassette insert compartments 7. According to the present embodiment, four cassette insert compartments 7 are provided which are accessible from an outer side of the base console A for allowing cassette to be inserted into or removed from the auto changer system 1. Each of the cassette insert compartments 7 is respectively openable and closable by upper and lower hatches 28*a*, 28*b*.

Also, the cassette transfer area CE of the base console A at upper and lower sides thereof, has horizontally disposed guide rails 8 mounted therein in base console A horizontal transport direction of the cassette transport mechanism 2. Further, according to the preferred embodiment, an electrically conductive drive rail 9 is provided substantially proximate and along the course of, the lower guide rail 8.

Also, the base console A is selectably connectable with one or more drive consoles B, cassette consoles C and/or elongate consoles D or with another base console A. When the base console A is connected with the elongate console D outer access via the input/output cassette cassette bay 5 is enabled.

Although according to the preferred embodiment, the present invention is drawn to an auto changer system 1 for the playing of tape cassettes, the present invention is not limited thereto. Alternatively, the invention is applicable to cassette playing and recording arrangements as well as to an auto changer for cassette casings mounting disks therein, such as data disks or other types of disk media.

Hereinbelow, an arrangement of the drive console B will be explained with reference to FIGS. 1, 4 and 5.

FIG. 4(*a*) is an enlarged plan view of a drive console portion of an auto changer device according to the embodiment, FIG. 4(*b*) shows a front view thereof.

FIG. 5 is a cross-sectional view of the auto changer device taken along line a—a of FIG. 4(*a*), FIG. 5(*b*) shows a right hand side view of the drive console drive console B of the auto changer according to the embodiment.

When the base console A and the drive console B are connected a rear portion of the base console may protrude in the longitudinal direction of the console. At a rear side of the cassette transfer area CE, the drive console B includes a cassette transfer area CE corresponding to that of the base console A and includes three playing devices 10 at an upper side thereof as well as small, upper and lower cassette bays 4. At a front side of the cassette transfer area CE a pair of large, upper and lower cassette bays 4 are provided.

A cassette insert opening 10*a* of each playing device 10 may be positioned to correspond with a cassette K in a cassette receiving compartment 6 of the cassette bay 4.

Also, the cassette transfer area CE of the drive console B at upper and lower sides thereof, has horizontally disposed guide rails 8 mounted therein in base console A horizontal transport direction of the cassette transport mechanism 2, further, according to the preferred embodiment, an electrically conductive drive rail 9 is provided substantially proximate and along the course of, the lower guide rail 8 as with the base console A.

Also, the drive console B is selectably connectable with one or more base consoles A, cassette consoles C and/or elongate consoles D or with another drive console B. When

the drive console A is connected with the elongate console D outer access via the input/output cassette cassette bay 5 is enabled.

Hereinbelow, an arrangement of the cassette console C will be explained with reference to FIGS. 1, 6 and 7.

The cassette console C includes a cassette transfer area CE corresponding to that of the base console A and includes large, upper and lower cassette bays 4 for receiving cassettes K in a plurality of cassette receiving compartments 6 of the cassette bay 4.

Also, the cassette transfer area CE of the cassette console C at upper and lower sides thereof, has horizontally disposed guide rails 8 mounted therein in base console A horizontal transport direction of the cassette transport mechanism 2. Further, according to the preferred embodiment, an electrically conductive drive rail 9 is provided substantially proximate and along the course of, the lower guide rail 8 as with the base console A.

Also, the cassette console C is selectably connectable with one or more base consoles A, drive consoles B and/or elongate consoles D or with another cassette console C. When the cassette console C is connected with the elongate console D access via the upper cassette cassette bay cassette bay 4 is enabled.

Now, referring to FIGS. 1, 8 and 9, the elongate console according to the invention will be described hereinbelow.

FIG. 6(*a*) is a plan view of a cassette console of the preferred embodiment while FIG. 6(*b*) shows a front view thereof. FIG. 7(*a*) is a cross-sectional view taken along line b—b of FIG. 6(*a*), FIG. 7(*b*) shows a right side view of the cassette console. FIG. 8(*a*) is an enlarged plan view of a base console according to the invention and FIG. 8(*b*) is a front view of the enlarged base console. FIG. 9(*a*) is a left side view of the base console of FIG. 8 and FIG. 9(*b*) shows the right side thereof.

The elongate console D is longitudinally aligned with the base console A such that the cassette transfer areas CE thereof correspond substantially. Further, the size of the base and elongate consoles is substantially the same. Mounted on the base console at an end of a cassette transfer area CE is a control box 3 having a small cassette bay 4 provided at upper and lower sides thereof. Each cassette bay 4 includes a plurality of cassette receiving compartments 6. Electrical circuitry for the control box control box 3 is also included.

Also, the cassette transfer area CE of the elongate console D at upper and lower sides thereof, has horizontally disposed guide rails 8 mounted therein in the horizontal transport direction of the cassette transport mechanism 2, further, according to the preferred embodiment, an electrically conductive drive rail 9 is provided substantially proximate and along the course of, the lower guide rail 8 as with the base console A.

Also, the elongate console D is selectably engageable in a first engagement direction and a second engagement direction crossing the first engagement direction, which may be perpendicular to the first engagement direction.

Referring to FIGS. 1, 8, 9 playing device 10 and 11, a cassette shuttle portion 11 of the auto changer system 1 according to the invention will be described hereinbelow. A plurality of cassette shuttle portions may be implemented in the auto changer system 1. Each cassette shuttle portion 11 includes a cassette insert opening 12 at one side thereof. A pair of the cassette shuttle portions are, according to the preferred embodiment, driven together by a single driving means.

Referring to FIGS. 10 and 11, FIG. 10 is a partially cut away perspective view of a cassette shuttle mechanism of the auto changer device of the invention and FIG. 11 is a plan view showing operational motion of the cassette shuttle mechanism. A pair of cassette shuttle portions 11 are shown affixed to the elongate console D. Extending proximate the pair of guide rails 8, a slide rail 13 is disposed along which a slide block 14 is movably disposed. The slide block 14 is engaged with a timing belt 15 disposed between a pair of pulleys 16. The pulley 16 is driven at one side by gears 17, 18 driven by a motor 19 engaged with a larger drive gear 20. Further, a pair of stoppers 21*a*, 21*b* are provided to limit the slidable area of the slide block 14.

At a lower side the slide block 14 is engageable with a rotation motor 22 and reduction gear 23. The rotation motor 22 and reduction gear 23 determine a rotational speed of an output axis 24 of the cassette shuttle portion 11. The output shaft 24 protrudes from an upper surface of the slide block and is active to rotate the cassette shuttle portion by ninety degrees. Further, a pair of stopper portions 25*a* and 25*b* are projected from the upper side of the slide block 14. Also, a stopper 26 is projected from a lower side of the cassette shuttle portion such that, when the stopper 26 engages the stopper 25*a* a first set positon of the cassette shuttle portion 11 is established and, when the stopper 26 engages the second stopper 25*b* a second set position of the cassette shuttle portion 11 is established.

Also, it is a feature of the invention that, for compactness, an overall width of the cassette transfer area CE is kept substantially equal to a width of the cassette shuttle portion 11.

When the pair of cassette shuttle portions 11 are positioned such that one is turned in a first direction and one in the second direction perpendicular to the first direction, the first cassette shuttle is positioned to receive a cassette K from a first cassette transport mechanism 2 and the second cassette shuttle portion is positioned to received another cassette K from a second cassette transport mechanism 2 associated, for example with a different console than the first cassette transport mechanism 2.

The cassette transport mechanism 2 according to the invention is movable horizontally within the modular consoles A–D along the opposed upper and lower guide rails 8, 8 thereof by means of a horizontally movable body portion 30. Further, a vertically movable cassette shuttle body 31 is enabled to move vertically between the upper and lower guide rails 8, 8. The vertically movable cassette shuttle body 31 is driven by driving means as will be described hereinbelow. Also, the vertically movable cassette shuttle body 31 is active to effect transport of the cassettes K between the cassette receiving compartments 6 and a playing device 10.

In addition, a console in a first engaging direction provided with a first cassette transport mechanism 2 and playing device 10 as well as a plurality of cassette receiving compartments 6 and a second console in a second engaging direction having a second playing device 10, cassette transport mechanism 2 and a plurality of cassette receiving compartments 6 may be implemented according to the invention.

FIGS. 12(*a*) and 12(*b*) respectively show plan and front views of a compact cassette auto changer system according to a preferred embodiment in which a second cassette transport mechanism 2 is impemented between a base console A and a drive console B. FIG. 13 is a plan view schematic diagram for explaining operation of a compact cassette auto changer system according to an embodiment of

the system of the invention including interchangable engagement between a plurality of drive consoles B and cassette consoles C. FIG. **14** is a plan view schematic diagram for explaining operation of an alternative embodiment of a cassette auto changer system auto changer system **1** according to the invention. The compact system of FIG. **14** is set in a different arrangement than that of FIG. **13** in that a single cassette console engages a plurality of drive consoles, although, similarly to FIG. **13**, a single engaging direction is utilized.

A view of a cassette auto changer system having an opposite relation to that of FIG. **14** is shown in FIG. **15**, which is a plan view schematic diagram of a biaxially operable cassette auto changer at a timing in which a front side of the drive console B is engaged with the elongate console D. Unlike FIG. **14**, the second axial direction is elongated. According to this, for example, if, a cassette from a cassette shuttle body **11** of the second cassette transport mechanism **2** is engaged via a transport mechanism F of the auto changer, to transport a cassette K in the second axial direction toward the other of the paired cassette shuttle bodies **11**, the other cassette shuttle body **11** of the other cassette transport mechanism **2** is urged in the first direction is engaged to transport a cassette K loaded therein to a playing device **10**.

FIG. **16** is a plan view schematic diagram of a biaxially operable cassette auto changer system arranged in a different structure than that of FIG. **13**. According to this variation, front sides of the drive console B and the cassette console C respectively engage a side of the elongate console D. According to this, the second axial direction is elongated relative to the first axial direction. According to this arrangement, a plurality of drive and cassette consoles can be continuously interchanged.

FIG. **17** is a plan view schematic diagram of a third embodiment of a biaxially operable cassette auto changer. According to this arrangement, a pair of cassette consoles and another pair of drive consoles are arranged opposed to a base console A to be continuously engaged via the elongate console D in the first axial direction.

FIG. **18** is a plan view schematic diagram of a fourth embodiment of a biaxially operable cassette auto changer. In this arrangement, a plurality of cassette consoles C are arranged in a first axial direction against a base console A. Some of the cassette consoles C are engaged at one side by an elongate console D having a drive console B and a cassette console C arranged ajacently thereto. Other of the axially aligned cassette consoles C are engaged at an opposite side by an elongate console D, a cassette console C and a drive console B. According to this, each elongate console D is always engaged at one side with a cassette console C and at another side by a drive console B. This arrangement is flexible in being arrangeable to avoid structural members **27** of a room in which it is installed.

FIG. **19** is a plan view schematic diagram of a fifth embodiment of a biaxially operable cassette auto changer. As may be seen, a protecting console E is disposed in a first axial direction relative the base console and is engaged at one side thereof by by an elongate console D having a drive console B and a cassette console C arranged ajacently thereto. Portions of the other side of the projecting console E are engaged by an elongate console D, a cassette console C and a drive console B. According to this, each elongate console D is always engaged at one side with a cassette console C and at another side by a drive console B. This arrangement is also flexibly arrangeable to avoid structural members **27** of an installation room.

Hereinbelow, a detailed description of a cassette transfer mechanism which may be utilized in the above described auto changer system will be set forth according to a first preferred embodiment thereof, with reference to FIGS. **20–22**. FIG. **20** shows a perspective view of a cassette transfer mechanism utilized in the system of the invention. FIG. **21** is a cross-sectional view taken along line c—c of FIG. **20**, while FIG. **22** is a cross-sectional view taken along line d—d of FIG. **20**. As may be seen in the drawings, The cassette transport mechanism **2** includes upper and lower horizontally arranged rack members **32** disposed so as to engage the upper and lower guide rails **8**, **8** disposed on each of the consoles A–D. A vertical pillar **30** is supported between the upper and lower rack members **32** so as to be movable in a horizontal plane. Upper and lower end portions **30***b*, **30***a* are attached to each end of the pillar **30**. As seen in FIG. **21**, each of the end portion a include a plurality of guide rollers **33** for pressingly engaging the guide rails **8** at three sides thereof, thus providing stable support and rolling movement for the cassette transport mechanism **2**.

Further, a vertical rod portion **30***c* of the pillar **30** has a horizontal travel motor **34** attached thereto such that a drive axis thereof projects vertically parallel to the pillar **30**. A pulley **35** mounted on the drive shaft of the motor **34** engages a timing belt which further engages a drive pulley **37** fixed on a vertically disposed rotatable shaft **38** from applying driving power via the rotatable shaft **38** to drive gears **39** affixed to each end thereof. The drive gears **39**, **39** are engaged with adjacent reduction gears **40**, **40** at each side thereof respectively. Smaller pinion gears are coaxially disposed at upper sides of the upper reduction gears **40**, **40** and lower sides of the lower reduction gears **40**, **40** to engage horizontal rack gear teeth formed on the upper and lower rack members **32**, **32**.

Also, referring still to FIG. **20**, the vertical rod portion **30***c* has a vertical guide rail **42** disposed along one side thereof. A vertical slider portion **43** engages the vertical guide rail **42** and supports a cassette shuttle body **31** thereon, extending horizontally from the vertical guide rail **42**. A vertical travel motor **44** is disposed at a lower side of the upper end member **30B** such that a drive shaft thereof projects horizontally to support a drive pulley **45** which drives an upper pulley **47** via a small timing belt **46**. The upper pulley in turn drives a coaxially mounted upper belt pulley **48** which is connected for co-rotation with a lower belt pulley **40** via a long vertically disposed timing belt **50**. The timing belt **50** provides driving power for vertically moving the cassette shuttle body **31** upward or downward along the guide rail **42** via the slider member **43**.

Thus, according to the above described structure, the cassette shuttle body **31** is movable in horizontal and vertical directions. The space occupied by the vertical and horizontal area in which the cassette shuttle body **31** is enabled to travel is defined as the cassette transfer area CE.

Further, referring to FIGS. **20** and **23**, the means be which driving power is provided to the cassette transport mechanism **2** will be explained hereinbelow. As will be noted in the drawings, an electrically conductive rail **9** is disposed parallel to the lower guide rail **8**. The electrically conductive rail **9** is engaged by a terminal member **60** at the lower end member of the pillar **30**. Electrical driving power for the motors, or the like, of the cassette transport mechanism **2** are thus provided via wiring **9***a* arranged within the pillar **9** and surrounding components.

FIG. **23** in an enlarged cross sectional view of a connecting structure between a transport rail and shuttle portion of

the cassette transfer mechanism. FIG. 24 is a cross sectional view taken along line c—c of FIG. 23.

According to this, sufficient driving power may be efficiently provided to a plurality of driven components with simple enclosed circuitry which can maintain a highly reliable condition.

Movement of the cassette transport mechanism 2 may be determined according to commands via an infrared signal or the like from the autochanger wherein a control box (see FIG. 1) of the base console A and/or the elongate console D effect tranmission while an input control box 3 of the cassette transport mechanism 2 is set in a reception mode. According to the invention the the control signal may be tranmitted via the same apparatus as the electrical power supply.

According to this, sufficient driving power may be efficiently provided to a plurality of driven components with simple enclosed circuitry which can maintain a highly reliable condition.

Hereinbelow, rotational operation of a casette shuttle body portion of the auto changer system 1 according to the invention will be explained in detail with reference to FIGS. 25–29. FIG. 25 is a perspective view of a driving portion of the cassette transfer mechanism and FIG. 26 is a perspective view of an alternative structure of a driving portion of a cassette transfer mechanism. FIG. 27 is a cross-sectional plan view of a rotational driving means of the cassette transfer mechanism. FIG. 28 is a cross-sectional front view of the rotational driving means of FIG. 27. FIG. 29 is a right side view of the rotational driving means.

As may be seen in the drawings, the vertical slider portion 43 movable along the vertical guide rail 42 has a first horizontal support projection 61 extending therefrom for supporting the cassette shuttle body 31. The first horizontal support projection 61 mounts a vertical rotation motor 62 on one surface thereof. A first harmonic gear type low speed drum 63 is affixed to an opposite side of the first horizontal support projection 61 via an attachment portion 63*a*. The lower speed drum 63 further includes a rotational input portion 63*b* to receive rotational force from the motor 62, a low speed output portion 63*c* to transmit the rotational force from the motor 62 input from the rotational input portion 63*b* to a vertical rotation arm 64. The low speed drum 63 has a cut-out portion 63*d* formed on an outer side thereof at a 90 degree rotation position and a rotation stopper portion 63*e* provided at the cut-out portion 63*d* to limit rotation of the vertical rotation arm 64.

According to this structure, the rotation of the vertical rotation arm 64 is limited to 90 degrees for rotating a cassette support body 67 which carries a cassette K therein.

It will be noted that the vertical rotation arm 64 has a mounting plate 64*a* extending perpendicularly from one side thereof. The mounting plate 64*a* has a second low speed drum 66 attached thereto for transferring rotational force from the motor 62 to the cassette support body 67. The second low speed drum is substantially the same as the above-described first low speed drum 63, having an attachment portion 66*a*, a rotational input portion 66*b*, a low speed output portion 66*c* to transmit the rotational force from the motor to the cassette support body 67. The low speed drum 66 has a cut-out portion 66*d* formed on an outer side thereof at a 180 degree rotation position and a rotation stopper portion 66*e* provided at the cut-out portion 66*d* to limit rotation of the cassette support body 67. Comparison of FIGS. 25 and 26 shows the rotational movement of the cassette support body 67 according to this arrangement.

It will be noted in FIGS. 25 and 26 that, according to the position of the cassette shuttle body 31, a cassette K may be loaded into a cassette receiving opening 10*a* of a playing device 10, or a cassette insert compartment 7 of a cassette IN/OUT port or into a cassette receiving compartment 6 of a cassette bay (rack) 4. Thus, these components may be arranged in any combination around the cassette transfer area CE allowing a compact structure to be flexibly designed.

As may be seen in FIG. 57, a horizontal rotation axis CO of the cassette transfer area CE is arranged at a center thereof so as to allow further compact design for the auto changer system 1.

Hereinbelow, a structure of the cassette support body 67 and the cassette shuttle body 31 of the auto changer system 1 according to the invention will be explained in detail with reference to FIGS. 30–36. FIG. 30 is a perspective view of a cassette support structure of the auto changer device. FIG. 31 is a plan view of the cassette support structure of FIG. 30. FIG. 32 is a cross sectional view of a rear side of a main portion of the cassette support structure. FIG. 33 is a cut way view of a right side of the main portion of the cassette support structure. FIG. 34 shows a perspective view of a magnetic head and mounting structure therefore and FIG. 35 is perspective view showing the structure of a cassette loading/unloading mechanism. FIG. 36(*a*) is a cross sectional view for explaining operation of a main portion of the head mounting structure while FIGS. 36(*b*), (*c*) and (*d*) illustrate operation of the main portion of the head mounting structure during left, right and upward positional variation thereof.

Referring to the drawings, it may be seen that the cassette support body 67 includes a base plate 68 attached to the rotational force output portion 66*c* of the second low speed drum 66. The base plate 68 has a concave groove 68*a* formed therein in forward and rearward directions for guiding movement of the cassette support body 67. A guide member 69 is attached at the surface of the concave groove 68*a* for receiving a slider member 70 disposed at the lower side of a first operational member 71. The first operational member 71 further has a rack gear 72 disposed on the lower side for engaging with a pinion gear 73 and associated gears 74, 75, 76 for receiving rotational force from a hand motor 77. Thus, the base plate 68 is supported in a rotatable fashion. As will be explained herein, the hand motor 77 controls forward and rearward motion of a cassette hand portion.

At an upper side of the first operational portion 71 a guide rail 78 is disposed in forward and rearward operational directions. The guide rail 78 slidingly supports a slider 79 which is attached to a second operational portion 80. Pulleys 81, 81 are disposed at forward and rear sides of the first (lower) operational portion 71 having a timing belt 82 supported therebetween for transferring operational force to the second (upper) operational member 80 according to a lower contact portion 68*b* of the base plate 68 and an upper contact portion 80*a* of the second operational portion 80 which touch the timing belt 82. And, it will be noticed that another guide rail 83 is disposed at an upper side of the second operational member 80 for engaging a slider 85 attached to a lower side of a positioning member 84 which allows left and right positioning of the mechanism for accurately positioning the apparatus for receiving or transferring of cassettes K.

It will be noted that, only according to movement of the first operational portion 71, is motive power transferred to

the timing belt **82** and thus to the second operational portion **80**. Thus, no separate driving source is necessary for the second operational portion **80**.

Referring to FIGS. **36**(*a*) to **36**(*d*), operation of a cassette hand adjustment mechanism G will be explained hereinbelow.

As mentioned above, the guide rail **83** is disposed at an upper side of the second operational member **80** for engaging a slider **85** attached to a lower side of a positioning member **84** which allows left and right positioning of the mechanism. A rod **90** is disposed in the left right direction of the mechanism on an upper side of the second operational member **80**. The left right movement is limited by a pair of link portions **86***a*, **86***b* at each end of the rod **90**. A coil spring **87** is disposed coaxially with the rod **90** between the two link portions **86***a*, **86***b*. The link portions **86***a*, **86***b* are urged against opposed center members **88***a*, **88***b* according to the spring force of the coil spring **87**. The center members **88***a*, **88***b* are positioned in relation to an axis of left right movement of the cassette support body **67**. The lower side of the positioning member **84** has two adjustment projections **89***a*, **89***b* disposed at an outer side of the link portions **86***a*, **86***b* between the link portions **86***a*, **86***b* and the center members **88***a*, **88***b*. The adjustment projections **89***a*, **89***b* determine the axis of left right movement of the cassette hand **93**.

Referring to FIGS. **39**(*b*) and **36**(*c*) movement in first and second directions N1 and N2 of the cassette hand cassette hand **93** is effected until the spring force of the coil spring **87** no longer urges the adjustment projections **89***a*, **89***b*.

Upward and downward adjustment of the cassette hand **93** is effected via a vertical rod **91** and a vertical guide rod **92** projected from an upper side of the positioning member **84**, as may be seen in FIG. **36**(*d*). One side of the cassette hand **93** includes a vertical bracket **94** attached thereto. An end of the vertical guide rod **92** passes therethrough via a boss **9***a* and is capped by a flanged cap member **95**. A coil spring **96** is disposed coaxially with the guide rod **92** between the cap member **95** and the end of the bracket **94**. Movement in the direction M is thus limited by the spring resistance of the coil spring **96**.

As seen in FIGS. **32–34**, the cassette hand mechanism I includes upper and lower fingers **97***a*, **97***b*, retained on a hand frame **94**. The upper finger **97***b* is movably disposed on a guide rail **98** of the hand mechanism I. A hand motor **97** is also mounted on the hand frame **94**. The hand motor **97** transfers driving power to the mechanism via first and second gears **100**, **101** to a torque limiter **102** to a second gear set consisting of a first smaller gear **10**, control box **3** and a larger gear **104** to a screw gear **105** which carries a threaded mounting plate **105** for moving the upper finger **97***b* upwards and downwards via the guide rail **98**.

Referring to FIG. **35**, when cassette extraction operation is effected, a curved arm **107** mounted via a pivotal member **108** to the hand frame **94** is utilized to actuate an extraction mechanism J. The other end of the curved arm **107** engages a cutout formed in one end of an extraction lever **109**. When the upper finger moves upward, the curved arm pulls the extraction lever **109** out. According to downward movement of the upper finger **97***b*, the curved arm **107** is pulled in a rearward direction by a coil spring **110** disposed between a inner side of the extraction lever and an underside of the curved arm **107**.

Further included in the mechanism of the cassette hand structure, supported on the base plate **68**, left and right cassette guide members **111** are disposed. The cassette guide members comprise and upper support portion **111***b* and a lower support portion **111***c* projected from upper and lower sides of a side wall portion **111***a*, forming a squared C-shape having a width W1 which is slightly greater than a width W2 of a cassette K (see FIG. **39**), the cassette guide members **111** are arranged so as to face each other to act as guides for receiving the sides of a cassette K. The cassette guide members **111** are supported by a pair of sliders **112** movable along the upper side of the base plate **68** via a pair of guide rails **113**.

The cassette guide structure L is driven by a motor **114**, the output of the motor **114** is transferred by gears **115**, **116** to a gear **117** which is coaxially mounted with a gear **119** via a torque limiter **118**. The gear **119** engages a gear **120***a* which drives a gear **122***a* via an intermediate gear **121**. The gear **122***a* has a screw shaft formed integrally and coaxially therewith. The motor **114** thereby drives the screw shaft **124** to rotate and drives a nut **125** which mounts the left slider **112** for driving the left cassette guide member **111**. Further, the gear **120***a* is coaxially mounted with a corresponding right side gear **120***b* via a shaft **123**. Thus rotation of the gear **120***a* also drives the gear **120***b*. The right side gear **120***b* engages a gear **122***b* which, similarly to the gear **122***a* coaxially mounts a screw gear **124** which is rotably mounted on a right side of the base plate **68**. The right side screw is driven to rotate and engages a right side nut **125** for driving the right side guide member via the slider **112**. It will be noted that the left and right side screw gears **124** are threaded so as to drive the left and right side cassette guide members **111**, **111** in opposite directions.

The cassette guide structure further includes left and right lower cassette guide members **126**, **126** provided on the first operational member **71** which are movable in forward and rearward directions together with movement of the first operational member **71**.

A unlocking lever **129** is mounted on an outer side of one of the lower cassette guide members **126** via a guide rail **127** and a slider **128**. The slider **128** is moveable between a forward stopper **131** and a rear stopper **132**. The unlocking lever **129** is biased in the forward direction by a coil spring **130** disposed between the forward stopper **131** and the rear side of the unlocking lever **129**. It will be noted that the spring force of the coil spring **130** is selected to be greater than that of a coil spring **142** associated with a cassette lock portion **141** as will be explained hereinlater.

Referring now to FIGS. **37–39** a structure of a cassette rack, or cassette bay **4** according to the invention will be described in detail.

FIGS. **37**(*a*) and **37**(*b*) show a perspective views of the configuration of a cassette bay **4** of the auto changer system including a cassette receiving compartments **6** (FIG. **37**(*b*)). FIG. **38** is a front view of the cassette bay **4**. FIG. **39** is a side view showing operation of cassette guide portions and a cassette receiving compartment.

As may be seen, the cassette bay **4** is a modular structure composed of a plurality of cassette receiving compartments **6**. The cassette receiving compartments **6** are joined via horizontal plates **135** which engage vertical cut out portions **136** at upper and lower sides of the cassette bay **4**. The cassette receiving compartments **6** each include upper and lower L-shaped cassette guides **137**, **137** which have beveled edges for easily guiding side portions of a cassette K into the cassette receiving compartments **6**. Further, the cassette receiving compartments **6** also include small cassette edge guides **139**, **139** and bottom guides **138**, **138** inwardly of the L-shaped cassette guides **137** for retained

small size cassettes, such as DAT cassettes of the like. The small size cassette edge guides **139** are retractable to a side area between the L-shaped cassette guides when not required so as to allow unimpeded loading and unloading of larger cassettes. Further, the cassette edge guides **139** are pivotably mounted on the L-shaped cassette guides **137** via an arm portion **139***a* outwardly biased by an expansion coil spring **140**. Thus, loading of both large and small size cassettes may be easily accomplished, as seen in FIG. **38**.

As noted above, a cassette locking lever **141** engaged by a coil spring **142** is provided at a forward side of one of the cassette bottom guides **138** on each of the cassette receiving compartments **6**. The locking lever is engaged by the unlocking lever **129** during cassette unloading for releasing the cassette for extraction. When a cassette is inserted into the cassette receiving compartments **6** the locking lever **141** is again engaged via the coil spring **142**. The locking lever **141** is positioned so as to be able to be utilized for both large or small size cassettes, whichever is loaded into the auto changer system **1**.

At each longitudinal end of each cassette receiving compartment **6**, positioning tabs **143** are projected. The positioning tabs **143** include a V-shaped cut out therein for enabling the positional detection means of the invention as will be explained further hereinafter.

FIGS. **40–55** show side, top and and enlarged side view of the interaction between the cassette hand **93** and the cassette receiving compartments **6** during cassette extraction, conveyance and insertion operations.

FIG. **40** shows a main portion of the cassette transfer mechanism during one phase of a cassette transfer operation thereof. FIG. **41** is side view of the cassette transfer operation at a second phase thereof. FIG. **42** is side view of the cassette transfer operation at a third phase thereof. FIG. **43** is a cross-sectional plan view of a cassette conveyance operation of the cassette transfer mechanism at a first operational phase. FIG. **44** is a cross-sectional plan view of a cassette conveyance operation of the cassette transfer mechanism at a second operational phase. FIG. **45** is a cross-sectional plan view of a cassette conveyance operation of the cassette transfer mechanism at a third operational phase. FIG. **46** is a front view of a cassette selection operation of the cassette transfer mechanism at a first phase of operation. FIG. **47** is a front view of a cassette selection operation of the cassette transfer mechanism at a third phase of operation. FIG. **48** is a front view of a cassette selection operation of the cassette transfer mechanism at a third phase of operation. FIG. **49** is a front view of a cassette selection operation of the cassette transfer mechanism at a fourth phase of operation. FIG. **50** is a front view of a main portion of the invention at the time of extraction of a cassette from the cassette shuttle compartment by the cassette transfer mechanism. FIG. **51** is a front view of a main portion of the invention at the time of insertion of a cassette from the cassette shuttle compartment by the cassette transfer mechanism. FIG. **52**(*a*) and (*b*) are front views respectively showing first and second stages of a positional disengagement operation of the cassette transfer mechanism and the cassette shuttle compartment. FIG. **53** shows a cross-sectional plan view of a relation between the tape transport mechanism and the cassette shuttle compartment daring a horizontal cassette transfer operation. FIG. **54**(*a*) shows a front view of a relation between the cassette shuttle compartment and a cassette guide portion while FIG. **54**(*b*) is a plan view of a relation between the cassette guide portion and a cassette shuttle mechanism of a tape playing unit. FIG. **55** is a perspective view of a lock release mechanism of the invention.

As may be seen, the cassette hand mechanism I is driven toward the front longitudinal opening of the cassette receiving compartment **6** according to positional determination made via a pair of sensors S provided on each side of the cassette hand mechanism I, as will be explained in detail hereinafter. While the cassette guides **126**, **126** are moved forward with the first operational portion **71**. The cassette guides **111**, **111** are brought towards the front of the cassette receiving compartment **6** for guiding the cassette K into or out of the cassette receiving compartment **6**. Also, the unlocking lever **129** is brought against the locking lever **141** to disengage same according to the greater spring force thereof and the upper and lower fingers **97***b*, **97***a* are inserted sufficiently to grasp the cassette K. According to the present embodiment, only the upper finger **97***b* is driven, although the mechanism may be arranged such that both upper and lower fingers may be driven towards and away from each other. Thus, the cassette K rests on the lower finger **97***a* and the upper finger **97***b* is driven downwardly so as to effect grasping operation to firmly hold the cassette to be moved to or from the unlocked cassette receiving compartment **6**. According to this, reliable tape transfer operation may be accomplished with efficiency.

As may be seen in FIG. **55**, When the cassette K is inserted into a cassette opening **10***a* of the playing device **10**, an indentation **10***c* is provided at the upper side **10***b* of the cassette opening so as to accommodate the upper finger **97***b* during cassette insertion and extraction from the playing device **10**.

FIG. **56** is a schematic front view illustrating a rotation area of the tape transport mechanism cassette transfer area CE according to the preferred embodiment of a cassette auto changer unit according to the invention. FIG. **57** is a partially cut-away plan view of the rotation area established for the cassette transfer mechanism shown in FIG. **56**.

The cassette transfer area CE includes a cassette rotation area RE established to allow rotation of the cassette shuttle body **31**. A width W4 is provided between the various consoles A–D for allowing rotation of the cassette support body **67** without significant extra space so as to maintain compactness of the auto changer system **1**. Similarly, a horizontal space W3 is provided for allowing rotation of the cassette support body **67** within a radius R1. A second radius R2 is defined to be smaller than the width W4. Thus, the auto changer system **1** according to the invention is maintained as compact as possible.

Next, a positional detection arrangement N according to the invention will be explained with reference to FIGS. **58–62**.

FIG. **58** is an enlarged view of a main portion of the cassette auto changer unit according to a preferred embodiment. FIGS. **59**(*a*)–(*c*) are an enlarged front views showing relations between the cassette shuttle compartment and a selection search portion of the auto changer unit according to operation thereof.

The positional detection arrangement N according to the invention utilizes position markers in the form of positioning tabs **143** which may be seen in FIGS. **1–9** and **12–19**. Referring to FIG. **58** it may be appreciated that these tabs **143** are provided at each longitudinal side of all cassette receving components including the cassette receiving compartments **6**, cassette insert compartment **7**, the cassette opening **10***a* of the playing device **10** as well as the cassette insert opening **12** of the cassette shuttle portion **11**.

Referring to FIG. **59**(*a*)–**59**(*c*), with reference to the positioning tabs **143** of the cassette receiving compartments

6, it may be seen that a detection affirmative indicator O is established at a point where the slanted sides of the V-shaped cut out **143***a* meet. These detection affirmative indicator points O are established along a line P corresponding to a longitudinal center line of a cassette side indicating optimal positional alignment. According to this, a light reflective portion of the cut out **143***a* may be established as a detection zone while a non-reflection portion may be set as a no detection zone.

The sensors S are of an optical type, provided in pairs at opposite sides of the base plate **68**, of the cassette shuttle body **31**, as seen in FIGS. **30**, **31**.

The sensors S scan the positioning tabs **143** along an X axis direction of the cassette shuttle body **31**. Scanning determination may be effected via encoding such as pulses from the horizonal motor **34** by a pulse counter or the like.

For effecting positional detection, detection start points (X1, Y1), (X5, Y5) are established on the cut out **143***a* of the positioning tabs **143**. Similarly, detection points (X2, Y2). (X3, Y3) and (X6, Y6), (X7, Y7) are defined. Based on data representative of these points, determination of the correct position indicating points (X4, Y4), (X8, Y8) may be derived according to the following equation.

$$X4=(X2+X3)/2$$

$$Y4=\{(Y2-Y3)/2\}+\tan(\theta/2)+Y1$$

$$X8=(X6+X7)/2$$

$$Y8=\{(Y6-Y7)/2\}+\tan(\theta/2)+Y5$$

Based on this data, the sensors can reliably determine a correct poisitioning of the cassette shuttle body **31** in relation to a cassette receiving compartment **6** of the cassette bay **4** or other cassette receiving component of the auto changer system **1** for assuring reliable operation and longer playing life of the cassettes K since they are not subject to damage due to faulty positioning of conveyance mechanisms, or the like.

FIG. **60** is a schematic diagram showing the configuration of a cassette transport device utilized in the auto changer unit. The drawing indicates a rotational center a of the cassette shuttle body **31** as well as a center b of a cassette support position G. The position of the sensors S are indicated by a point c and d is a center line of an insert opening of the cassette receiving compartment **6**. In addition, center positions f (X9, Y10) of each of the positioning tabs **143** may be determined as follows.

$$X9=(X4+X8)/2$$

$$Y9=(Y4+Y8)/2$$

In addition, angular discrepancy between the cassette shuttle body **31** and the cassette receiving compartments **6** for determining a correction angle A may be determined as follows.

$$A=\tan^{-1}\{(Y4-Y8)\div(X4-X8)\}$$

In addition, from determination of the correction angle A, d(X, Y) is:

$$X=X9|B\times\cos(A)|$$

$$Y=Y9|B\times\sin(A)|$$

FIG. **61** shows an operational phase of a positional adjustment operation of the cassette shuttle compartment. FIG. **62** shows a second operational phase of a positional adjustment operation of the cassette shuttle compartment. According to the positional determination of the invention correction determination may be foregone since correct positional detection is reliably assured.

Hereinbelow, a cassette IN/OUT port arrangement according to the invention will be described with reference to FIGS. **63–69**.

FIG. **63** is a perspective view of a cassette receiving rack of the auto changer unit. FIG. **64** is a perspective view of a hatch opening/closing mechanism. FIG. **65** shows a plan view of the cassette receiving rack of FIG. **63**. FIG. **66** shows a front view of the cassette receiving rack. FIG. **67** shows a cross-sectional view of the cassette receiving rack. FIG. **68** is a block diagram of a cassette IN/OUT circuit according to the invention. FIG. **69** is a flow chart for explaining an operational process of the cassette IN/OUT circuit of FIG. **68**.

Referring to the drawings, the cassette IN/OUT port structure Q includes a hatch **28***a* opening to an input/output cassette cassette bay **5** having a plurality of cassette insert compartments **7** arranged therein. On a panel at the outer side of a housing of the auto changer system **1**, two LEDs **222**, **223** are provided beside each cassette insert compartment **7** and a open/close button **221** is provided on a control panel **220**. Divider plates **209** are provided between each of the cassette insert compartments **7**.

As may be seen, the hatch **208***a* is driven via a motor **211** and a torqure reduction portion **212** through a gear train **200** including a worm gear **212** and gears **213–218**. The gear **218** engages a rack gear provided on a rear side of the hatch **28***a* to drive the hatch **28***a* in opening or closing directions along guide rods **220** according to actuation of the opening/closing button **221**.

According to the present embodiment, four cassette insert compartments **7** are provided in the input/output cassette cassette bay **5** which is provided in the base console A of the auto changer system **1**.

A YES/NO sensor is provided at the cassette port for determining whether a cassette is present in each of the cassette insert compartments **7** of the input/output cassette cassette bay **5**. The sensor arrangement **201** provides optical sensors **201***a*-1, **201***a*-2, **201***b*-1, **201***b*-2, **201***c*-1, **201***c*-2, **201***d*-1, **201***d*-2, a pair of sensors being provided at each cassette insert compartment **7**. Thus the LED **222** indicates the cassette insert compartment **7** may not be used and the LED **223** indicates that the cassette insert compartment **7** may be used. Determination being made by a controller **202**.

Referring to FIG. **68** and steps S1 to S9 of FIG. **69**, it may be seen that the controller **202** is active such that, when a YES indication determined by the YES/NO sensor changes to a NO determination, the control means sets the cassette port at an IN port empty condition and lights the LED indicator **223** and, when the IN port empty condition of the YES/NO sensor changes to a YES condition wherein a cassette is present in the cassette port, operation of the tape transfer mechanism to the cassette port is disabled and a IN port loaded condition is determined. Further, in an IN port empty condition of the cassette port, operation of the tape transfer means is detected by the YES/NO sensor, the control means determines an OUT port loaded condition of the cassette port and sets the LED **222**. When such an OUT port loaded condition changes from YES to NO as determined by the YES/NO sensor arrangement **201**, an IN port empty condition of the cassette port is determined by the control means. The controller **202** receives input from a lower hatch open deytector **240**B and an upper hatch open

detector **240***a* as well as cassette selection search units **201** whereat cassettes may be selected by an operator.

The contoller also includes a memory unit associated with the control means for memorizing a state of the cassette port.

According to operation of the controller **202** access to the **5***b* is disable during a switching state of the YES/NO sensor or of a port condition determination be the control means. However, cassette extraction from outside the input/output cassette cassette bay **5** of the auto changer during switching from an IN port to an OUT port determination of the control means is permitted.

FIG. **70** is an enlarged front view of a main portion of a cassette transport arrangement according to an alternative embodiment of the invention. As may be seen, the pillar **30** is supported on a base platform **252** having wheels **33** and a motor **34** connected to a gearing mechanism **251** to drive a pinion gear **250** at a lower side of the base platform to engage the rack gear **32**. In other respects, the arrangement is the same as described above.

FIG. **71** shows an enlarged front view of a main portion of a cassette transport arrangement according to another alternative embodiment of the invention. According to this modification, the motor **34** may power a drive tire **253** and the wheels **33** are vertically on top of the guide rail **8** as well as horizontally similarly to the drive tire to run the horizontal moving arrangement along the top side of the guide rail **8** according to frictional force.

FIG. **72** is a diagram of a main portion of a cassette support arrangement according to an alternative embodiment of the invention. According to this, only one cassette guide portion **254** is provided on the cassette support body **67**

FIG. **73** is a diagram of a main portion of a cassette support arrangement according to another alternative embodiment of the invention. According to this, two vertical guide members **255** are provided instead of the C-shaped members **111** of the first embodiment.

FIG. **74** is a diagram of a modification of the cassette support arrangement of the invention. According to this variation, the cassette guide members **111**, **111** are formed to be L-shaped, having no upper support portion **111***b*.

FIG. **75** is a perspective view of a lock disengaging mechanism for a cassette shuttle compartment according to the alternative embodiment. This modification provides the lock release lever **129** (i.e. unlocking lever) on the side of the cassette hand **93**.

FIG. **76**(*a*) is a side view of an interior of a cassette console and, FIG. **76**(*b*) shows a front view of the console interior according to a first preferred embodiment thereof. According to this, the longitudinal orientation of the cassette receiving compartments **6** as well as the playing device **10** is established to be horizontal. Thus, the tape transport mechanism only travels in the vertical direction, thus reducing costs while providing a more compact mechanism.

FIG. **77**(*a*) is a plan view of an interior of a cassette console according to another modification, and FIG. **76**(*b*) shows a front view of the console interior according thereto. According to this, the longitudinal orientation of the cassette receiving compartments **6** as well as the playing device **10** is established to be horizontal. Thus, the tape transport mechanism only travels in the vertical direction while being rotatable and including the rotation are RE between upper and lower cassette bays **4**.

FIG. **78** is a partial front view of an interior of a fully assembled cassette auto changer unit according to the preferred embodiment. The positional detection arrangement N according to this modification is simplified and includes a plurality of positioning tabs **256** having a square opening defined therein. FIG. **79** is a front view of a positional adjustment means utilized in the auto changer unit. As may be seen, The same point may be established for positional determination.

FIG. **80** is an explanatory diagram of a positional adjustment means according to another modification according to the invention. According to this, the positioning tabs **143** are provided only at upper and lower sides of the cassette bays **4** to guide the vertical position for the cassette shuttle body **31**. According to this, sufficiently accurate determination may be accomplished.

FIG. **81** is an explanatory diagram of a positional adjustment means according to another modification according to the invention. In this modification, the positioning tabs **268** provide only a small opening for indication of a correct position. The sensors **267** are supported at each side of the cassette support body **67** for effecting positional detection.

According to these modifications, the auto changer system **1** according to the invention may be provided at reasonable cost without extreme complexity of manufacture. In addition, the auto changer system **1** may be maintained in a very compact and flexible condition such that it may be adaptably installed in various locations with highly different space requirements.

Of course, the cassette transport mechanism **2** of the auto changer system **1** is operable to and from the input/output cassette cassette bay **5** whereby cassettes may be inserted into and removed from the housing console. The controller **202** allows the single input/output cassette cassette bay **5** to function as both an IN or an OUT port.

Thus, according to the present invention as described herein above, there is provided a compact, reliable cassette auto changer apparatus having a relatively uncomplicated structure.

According the invention, a cassette auto changer system is provided wherein manufacturing expense and complexity are minimized while assuring a highly functional unit which may be installed in a comparatively small area space.

Also, according the invention, a cassette auto changer system is provided which is simplified and has a reduced number of components.

In addition, a cassette auto changer system is provided wherein reliable determination of positioning between components is assured.

In addition, a cassette auto changer system is provided in which reduced electrical requirements and simplified wiring, are provided as well as smaller capacity cable and cassette locking and release mechanisms which are simplified.

The cassette auto changer system of the invention as disclosed above may execute cassette transfer operations in a reduced space is necessary for providing a compact apparatus.

The cassette auto changer system of the invention also provides flexible use of port openings according to an operation desired by the user.

It will be noted that, although the preferred embodiment is set forth in terms of an auto changer system for tape cassettes, the present invention may be embodied in various different ways without departing from the principle of the invention as herein set forth.

The present invention in not limited only to the description as herein disclosed but may be modified and embodied in other ways without departing from the scope or inventive concept of the invention as set forth above.

What is claimed is:

1. A cassette auto changer system including tape signal reading means and selection means for selecting between a plurality of cassettes, comprising:

base console means including a port for tape insertion or extraction operations and having a tape insert compartment, said base console means having upper and lower guide rails;

drive console means for mounting said tape signal reading means;

cassette control means for mounting a plurality of compartments for storing tape cassettes; and

tape transfer means for transporting tape cassettes selectively between said base console means, said drive console means and said cassette console means; and

an extended base console which is interconnected with one console of said base console means, said drive console means, and said cassette console means in a first direction with said base console means, said drive console means, and said cassette console means being interconnected with each other in an arbitrary order in said first direction, and said extended base console is interconnected with one console of said base console means, said drive console means and said cassette console means in a second direction which is generally perpendicular to said first direction; and

said extended base console including a cassette receipt/delivery mechanism to move a cassette between said first direction and said second direction;

an electrically conductive rail disposed proximate to said guide rails which is powered by enclosed electrical wiring circuitry wherein;

an unmagnetized cassette shuttle body of said transfer means is driven along said electrically conductive rail and guided along said guide rails; and

wherein electrical current is input to said tape transfer means from said electrically conductive rail via said cassette shuttle body.

2. A cassette auto changer system as set forth in claim 1, wherein said base console means includes first drive means of said drive console means and first cassette consoles of said cassette console means thereon arranged in a first axial direction and, at a position opposed to said first drive means and first cassette consoles, second drive means of said drive console means and said second cassette consoles of said cassette console means are arranged in a second axial direction different from said first axial direction, said tape transfer means being disposed between said first and second drive means and said respective first and second cassette consoles for transporting tape cassettes between said cassette console means and said drive console means.

3. A cassette auto changer system as set forth in claim 2, wherein said tape transfer means includes a first tape transfer mechanism operable along said first axial direction and a second tape transfer mechanism operable along said second axial direction.

4. A cassette changer system as set forth in claim 3, wherein said first drive means and said first cassette consoles are provided on a first base console of said base console means while said second drive means and said second cassette consoles are provided on a second base console of said base console means, proximate to said first base console.

5. A cassette auto changer system as set forth in claim 2, wherein said first and second drive means and said respective first and second cassette consoles are adjustably interchangeable along said first and second axial directions.

6. A cassette auto changer system as set forth in claim 2, wherein said tape signal reading means comprises a plurality of tape playing devices.

7. A cassette auto changer system as set forth in claim 2, wherein said tape signal reading means comprises a plurality of tape playing and recording devices.

8. A cassette auto changer system as set forth in claim 2, wherein said tape signal reading means comprises a tape playing apparatus.

9. A cassette auto changer system as set forth in claim 1, wherein said tape signal reading means comprises a plurality of tape playing devices.

10. A cassette auto changer system as set forth in claim 1, wherein said tape signal reading means comprises a plurality of tape playing and recording devices.

11. A cassette auto changer system as set forth in claim 1, wherein said tape signal reading means comprises a tape playing and recording apparatus.

12. A cassette auto changer system including means for selectably providing a plurality of cassettes to be loaded into one or more tape signal reading means, comprising:

base console means including a port for tape insertion or extraction operations and having a tape insert compartment, said base console having horizontally disposed guide rails;

drive console means for mounting said tape signal reading means;

cassette console means for mounting a plurality of compartments for storing tape cassettes;

a tape transfer mechanism operable to selectably transport cassettes between said cassette rack and said tape signal reading means;

an extended base console which is interconnected with one console of said base console means, said drive console means, and said cassette console means in a first direction with said base console means, said drive console means, and said cassette console means being interconnected with each other in an arbitrary order in said first direction, and said extended base console is interconnected with one console of said base console means, said drive console means and said cassette console means in a second direction which is generally perpendicular to said first direction;

said extended base console including a cassette receipt/delivery mechanism to move a cassette between said first direction and said second direction;

an electrically conductive rail disposed proximate to said guide rails which is powered by enclosed electrical wiring circuitry;

wherein said tape transfer mechanism includes a movable unmagnetized cassette shuttle body of said tape transfer mechanism which is capable of at least horizontal rotation, said cassette shuttle body being driven along said electrically conductive rail and guided along said guide rails; and

wherein electrical current is input to said tape transfer mechanism from said electrically conductive rail via said cassette shuttle body;

a transfer area whereat vertical movement of said tape transfer mechanism occurs; and

a rotation area is provided for allowing rotation of said cassette shuttle body of said tape transfer mechanism.

13. A cassette auto changer system as set forth in claim 12, wherein a width of said transfer area is established to be substantially the same dimension as a width of said cassette shuttle body.

14. A cassette auto changer system as set forth in claim 12, wherein said transfer area is established to be substantially the same as said rotation area.

15. A cassette auto changer system including means for selectably providing a plurality of cassettes to be loaded into one or more tape signal reading means, comprising:

base console means including a port for tape insertion or extraction operations and having a tape insert compartment;

drive console means for mounting said tape signal reading means;

cassette console means for mounting a cassette rack including a plurality of compartments for storing tape cassettes;

a tape transfer mechanism operable to selectably transport cassettes between said cassette rack and said tape signal reading means;

said base console means includes horizontally disposed guide rails at upper and lower sides of said cassette rack;

an electrically conductive rail disposed proximate to said horizontally disposed guide rails which is powered by enclosed electrical wiring circuitry; wherein

an unmagnetized cassette shuttle body of said tape transfer mechanism is driven along said electrically conductive rail and guided along said horizontally disposed guide rails;

an extended base console which is interconnected with one console of said base console means, said drive console means, and said cassette console means in a first direction with said base console means, said drive console means, and said cassette console means being interconnected with each other in an arbitrary order in said first direction, and said extended base console is interconnected with one console of said base cassette means, said drive console means and said cassette console means in a second direction which is generally perpendicular to said first direction;

said extended base console includes a cassette receipt/delivery mechanism to move a cassette between said first direction and said second direction,

wherein electrical current is input to said tape transfer mechanism from said electrically conductive rail via said cassette shuttle body.

16. A cassette auto changer system including means for selectably providing a plurality of cassettes to be loaded into one or more tape signal reading means, comprising:

base console means including a port for tape insertion or extraction operations and having a tape insert compartment, said base console means having horizontally disposed guide rails;

drive control means for mounting said tape signal reading means;

cassette console means for mounting a cassette rack including a plurality of compartments for storing tape cassettes;

a tape transfer mechanism operable to selectably transport cassettes between said cassette rack and said tape signal reading means;

an extended base console which is interconnected with one console of said base console means, said drive console means, and said cassette console means in a first direction with said base console means, said drive console means, and said cassette console means being interconnected with each other in an arbitrary order in said first direction, and said extended base console is interconnected with one console of said base console means, said drive console means and said cassette console means in a second direction which is generally perpendicular to said first direction; said extended base console including a cassette receipt/delivery mechanism to move a cassette between said first direction and said second direction;

an electrically conductive rail disposed proximate to said horizontally disposed guide rails which is powered by enclosed electrical wiring circuitry;

an unmagnetized cassette supporting shuttle body, operably associated with said tape transfer mechanism; and

a cassette hand portion connected with said cassette supporting shuttle body for extracting a selected one of said cassette receiving compartments of said cassette rack; and wherein

said cassette hand portion further includes an unlock lever, engageable with a corresponding lock lever of said cassette receiving compartments for effecting an unlocked state of said cassette receiving compartment during engagement with said cassette hand portion for facilitating said extraction operation; and

wherein electrical current is input to said tape transfer mechanism from said electrically conductive rail via said cassette shuttle body.

17. A cassette auto changer system as set forth in claim 16, further including cassette hand portion driving means for driving said cassette hand portion with said cassette hand portion having finger portions projecting therefrom, said cassette hand portion driving means moving said cassette hand portion to grasp a selected cassette via said finger portions.

18. A cassette auto changer system as set forth in claim 17, wherein only one side of said finger portions of said cassette hand is driven by said driving means for effecting said grasping operation.

19. A cassette auto changer system as set forth in claim 16, wherein said cassette hand portion further includes a guide member positioned so as to oppose a selected one of said cassette receiving compartments of said cassette rack during tape transfer operation, a slider member movable forward and away from said tape receiving compartment, said unlock lever being provided on said slider member of said cassette hand portion.

20. A cassette auto changer system as set forth in claim 16, wherein said cassette hand portion further includes a pair of stopper members positioned so as to oppose a selected one of said cassette receiving compartments of said cassette rack during tape transfer operation, a slider member movable forward and away from said tape receiving compartment in an area between said stopper members, wherein on one side of one of said stopper members, said unlock lever is disposed.

21. A cassette auto changer system including means for selectably providing a plurality of cassettes to be loaded into one or more tape signal reading means, comprising:

base console means including a port for tape insertion or extraction operations and having a tape insert compartment;

drive control means for mounting said tape signal reading means;

cassette console means for mounting a cassette rack including a plurality of compartments for storing tape cassettes;

a tape transfer mechanism operable to selectably transport cassettes between said cassette rack and said tape signal reading means;

an extended base console which is interconnected with one console of said base console means, said drive console means, and said cassette console means in a first direction with said base console means, said drive console means, and said cassette console means being interconnected with each other in an arbitrary order in said first direction, and said extended base console is interconnected with one console of said base console means, said drive console means and said cassette console means in a second direction which is generally perpendicular to said first direction; said extended base console including a cassette receipt/delivery mechanism to move a cassette between said first direction and said second direction;

upper and lower guide rails disposed at an upper side of said auto changer system;

a horizontally movable slider portion of said tape transfer mechanism disposed above said guide rails;

an electrically conductive rail disposed proximate to said guide rails which is powered by enclosed electrical wiring circuitry;

an unmagnetized cassette shuttle body movable along a vertical path intersecting a horizontal path of said slider portion, said cassette shuttle body being driven along said electrically conductive rail and guided along said guide rails;

cassette shuttle body driving means for driving said cassette shuttle body for horizontally moving said slider portion; and

wherein electrical current is input to said tape transfer mechanism from said electrically conductive rail via said cassette shuttle body.

22. A cassette auto changer system as set forth in claim **21**, wherein said upper and lower guide rails further include upper and lower gear rack portions, and said slider portion further includes upper and lower pinion gears for effecting movement along said guide rails, said pinion gears being driven by said driving means.

23. A cassette auto changer system including means for selectably providing a plurality of cassettes to be loaded into one or more tape signal reading means, comprising:

base console means including a port for tape insertion or extraction operations and having a tape insert compartment, said base console means having horizontally disposed guide rails;

drive control means for mounting said tape signal reading means;

cassette console means for mounting a cassette rack including a plurality of compartments for storing tape cassettes;

a tape transfer mechanism operable to selectably transport cassettes between said cassette rack and said tape signal reading means;

an electrically conductive rail disposed proximate to said guide rails which is powered by enclosed electrical wiring circuitry

an extended base console which is interconnected with one console of said base console means, said drive console means, and said cassette console means in a first direction with said base console means, said drive console means, and said cassette console means being interconnected with each other in an arbitrary manner in said first direction, and said extended base console is interconnected with one console of said base console means, said drive console means and said cassette console means in a second direction which is generally perpendicular to said first direction; said extended base console including a cassette receipt/delivery mechanism to move a cassette between said first direction and said second direction;

said tape transfer mechanism including an unmagnetized cassette supporting shuttle body including an opposed pair of cassette guide portions engageable with opposed side portions of a cassette disposed in a selected cassette receiving compartment of said cassette rack, said cassette shuttle body being driven along said electrically conductive rail and guided along said guide rails;

centering means for driving said cassette guide portions in left and right directions in relation to an axis thereof for effecting centering operation of said cassette guide portions; and

wherein electrical current is input to said tape transfer mechanism from said electrically conductive rail via said guide rails.

24. A cassette auto changer system as set forth in claim **23**, wherein said opposed cassette guide portions further include support members for supporting said opposed sides of said cassette; an upper support portion for supporting an upper edge of said opposed side portions of said cassette; and a lower support portion for supporting a lower side of said cassette.

25. A cassette auto changer system as set forth in claim **24**, wherein a space between said upper and lower support portions of said cassette guide portions is set to be greater than a width dimension of said cassette receiving compartments of said cassette rack.

26. A cassette auto changer system as set forth in claim **23**, wherein said cassette shuttle body is movable along a cassette insertion/extraction direction relative to said cassette rack, and, said shuttle body further including a cassette hand portion operable for grasping operation at lower and upper sides of a selected cassette, opposed grasping members of said cassette hand member being drivably movable toward and away from each other in a width direction of said cassette.

27. A cassette auto changer system as set forth in claim **26**, wherein said cassette hand portion further includes centering means including left and right spring members for driving cassette guide portions in left and right directions in relation to an axis thereof for effecting centering operation of upper and lower grasping members of said cassette hand; wherein left and right spring force of said spring members effect centering operation of said grasping members at a support position of said cassette hand.

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